

# Electrical Construction and Maintenance

*With which is consolidated ELECTRICAL CONTRACTING*

JUNE 1947

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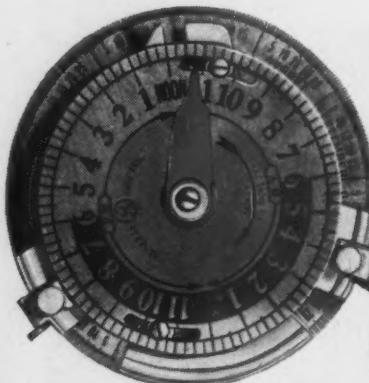
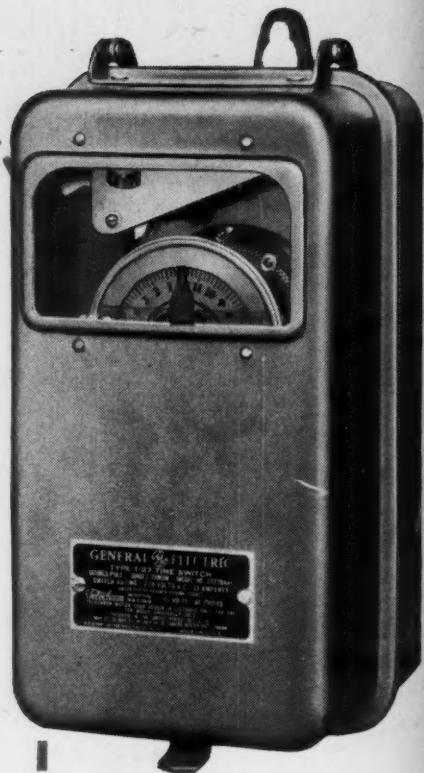
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# Electrical Construction and Maintenance

With which is consolidated Electrical Contracting,  
The Electragist and Electrical Record...Established 1901

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering installations, repairs, maintenance and management, in the field of electrical construction and maintenance.

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## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

Industrial and Commercial Lighting Equipment Section





JUNE, 1947

# FRAMEWORK FOR LIGHTING PROGRESS

PLANNED LIGHTING is much more than a routine layout with an attached bill of materials. A symmetrical pattern of well chosen lighting fixtures can, and frequently does, provide good lighting. But the lighting effect is too often an accidental result of fortunate spacings, of ceiling and wall colors, or of a particular quality in the chosen fixture which makes it especially suitable for that application.

WITH THE VARIETY of high grade, well engineered, luminaries now available, the chances of producing acceptable lighting are better than ever. The fine art of hanging new fluorescent fixtures on existing outlets may produce far better illumination than that which prevailed before, since, as a result of the substantial advances in lamps and fixture design during recent years, some improvement in light is inevitable. Let us compare such jobs, however, with others using perhaps identical fixtures skillfully applied in appropriate surrounds to produce a specific lighting effect. Here good lighting is a result of design, not of chance. Here is the very essence of planned lighting.

STARTING FROM a desired lighting result; the footcandles, the brightness ratio, the color and other necessary qualities; the planning of the lighting system is a technical job which requires not only a sound knowledge of lighting principles, but a comprehensive knowledge of available lighting equipment and components. Planning is fruitless if the resulting system is a commercially impractical array of custom built equipments. Planned lighting is essentially practical and economical.

BETWEEN THE EXTREMES of the accidentally good installation which results from rule-of-thumb layouts and the completely special design there is a great area of practical lighting application that deserves the critical attention of our best technical brains and our best commercial initiative. We know how to provide good lighting. We have excellent lamps, components and fixtures in wide variety. We have competent knowledge of the influence of layout and surrounds. The critical phase of planned lighting today is the effective coordination of these materials and this knowledge in applied lighting.

THE COMMERCIAL and industrial lighting fixture manufacturers recognize the compelling importance of an all-industry attack on the market ahead. It is this group which is fostering the International Lighting Exposition in November which will do much to bring out the most modern of today's lighting schemes. It remains for all of the men who plan and install lighting systems to appreciate their individual responsibilities for the progress of modern lighting. For it is only out of their every day judgements in planned lighting applications that real progress can come.

*Wm. D. Stuart*

**Electrical Construction and Maintenance**

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and  
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# CONTROLS For SERVICE

**Sectionalized, dual distribution of electric power and lighting facilities are combined with automatic electrical controls to improve safety, efficiency and operating economies for the modern store.**

By Hugh P. Scott

THE recently-completed renovation and reconstruction of an office building into Lane Bryant's new ten-floor store for women on New York's smart Fifth Avenue includes the installation of a new a-c distribution system, the extensive utilization of remote and automatic controls and a complete new installation of modern lighting specially designed for retailing. The a-c installation, involving the complete changeover of all lighting and a part of the motorized equipment from an inadequate d-c system, was completed without interruption of electrical service and now provides additional capacity to meet the demands of a greatly-expanded electrical plan. Controls for lighting and motored operations include remote magnetic contactors, time switches, thermostatic and pressure elements and a system of electric interlocks for protection of the air conditioning plant. Lighting combines modern design and installation techniques with functional application and color correction. The installation reveals progressive thinking and emphasizes the dependence of modernization on electrical evolution, expansion and advancement.

Requirements of the unified Lane Bryant organization differ materially from those which served the former multiple-tenant commercial occupancy. Additional elevator service, air conditioning, fluorescent lighting and centralized switchboards are among those

items which necessitated a revamped electrical system. Also included in the electrical contract was the installation of conduit for fire and sprinkler alarms, watchman's clock system, telegraph, paging and both inter-departmental and public telephone service.

## Dual Distribution

Continuity of electrical service is insured through the installation of a dual system of distribution with the main switchboard divided into two separate sections serving separate feeders and load centers. With this arrangement, alternate lights on all floors, motors for alternate elevators and all other major electrical duplications are fed from separate circuits.

This dual distribution system originates at the transformer vault, where two service take-offs are provided, and extends from the a-c transformer vault to the two main switchboard sections through duplicate runs of twenty 500 MCM cables (5 per phase and 5 for neutral). Should a fault develop in either service, a section of the switchboard, or in the internal distribution system, the store would not be subjected to the complete interruption of service.

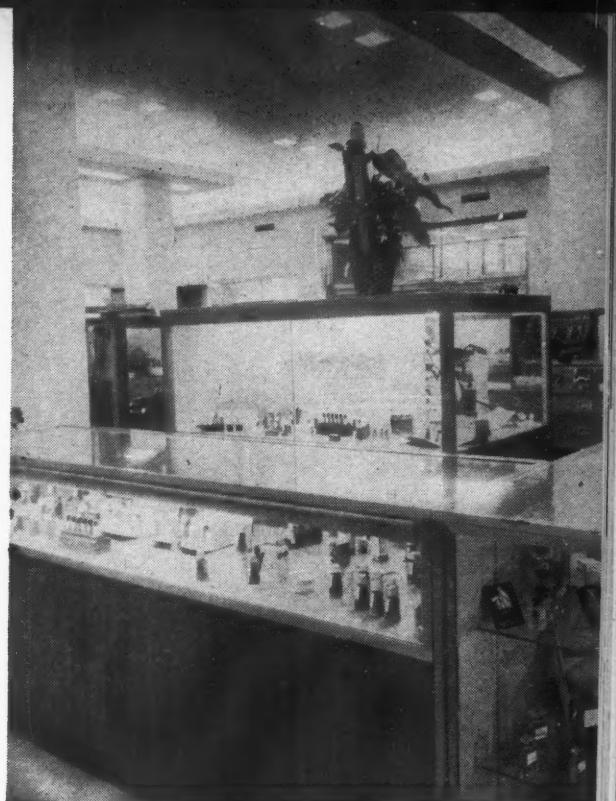
Flexibility of showcase and sales-counter arrangements is achieved on all merchandising floors by connecting the electrical circuits of adjacent cases and counters with connectors, plugs,

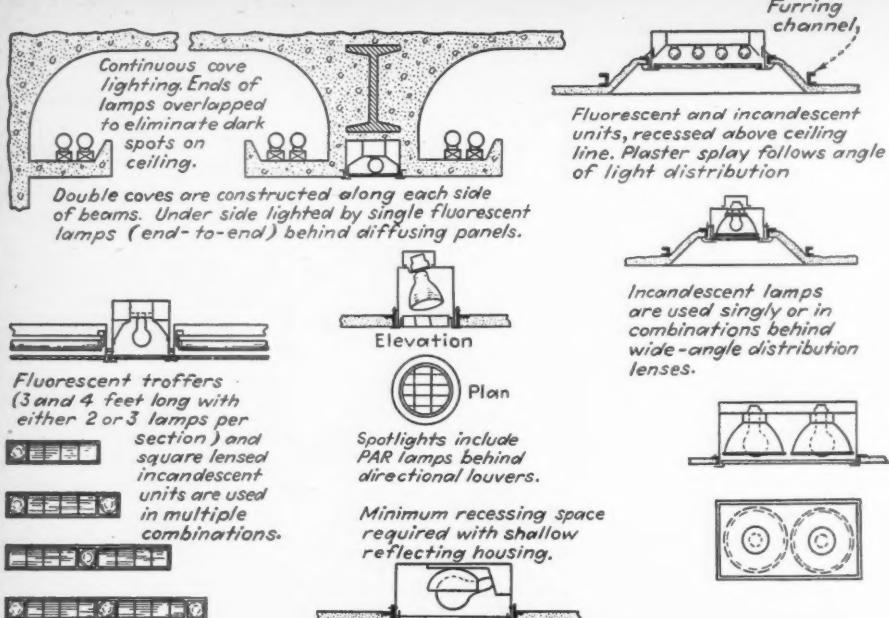
*Illumination plan of main floor includes cove lighting for cornices and column borders, recessed lensed incandescent units for general illumination, diffused fluorescent runs as decorative motifs between columns, and slimline case lighting to display merchandise.*

jumpers and fittings. By connecting counters together with flexible metallic sheathed jumpers instead of to separate floor outlets, a single floor receptacle serves an entire bay or series of units, permitting the counters and cases to be shifted for seasonal variety and to meet departmental requirements. It is believed that shopper interest will be periodically stimulated by these easily-created variations in merchandising presentations and by corresponding variations in controlled lighting.

As now installed, the original d-c utility service has been reduced in capacity and supplies a new switchboard through a 600-amp., 2-pole, 2-wire service switch. Those d-c motors which were retained (sewage, condensate return and house pumps, sprinkler system and freight elevator) have a total hp. of 140 and are connected to the new board by feeders rerouted to suit the new structural alterations and recontrolled to provide for the new requirements of Lane Bryant.

The new a-c service passes through two 2000-amp., 3-pole, 4-wire, manually operated disconnect switches to feed the main switchboard, and through two 800-amp., 3-pole, 3-wire switches





**Fixture designs and installation details are influenced by available recessing space, location of structural features, general decorative plan of departments, specific purpose of the lighting units, and mounting heights.**

**Plaster splays rise from level of suspended ceiling to distributing lenses shielding square fluorescent fixtures (each with four 20-watt lamps on 5-inch centers mounted 2 inches above glass panels) and round incandescent units.**

to a refrigeration control panel. Refrigeration equipment includes two 200-hp. compressors while other new a-c motors (elevators, unit heaters, exhaust fans and pumps for fuel oil, cooling tower, chilled water and condensate) have a combined capacity of an additional 180 hp. The various load centers are connected to the main switchboards through six power feeders and 15 lighting feeders. Load centers control 33 power and 828 lighting branches. Utility a-c service is 208/120-volt, 3-phase, 4-wire, 60-cycle.

All wiring is in rigid steel conduit,  $\frac{3}{4}$ -inch minimum diameter. The minimum gage of wire is No. 12. Rubber insulation on all conductors throughout the store is type RH. Where conductors are carried underground or run in damp or wet locations, they are lead sheathed or RW insulated.

In the interest of safety, all stairway, exit, elevator and service lighting is controlled and served by separate panels and risers.

Switchboards are of safe, dead-front construction, entirely enclosed by steel housings, with continuous pull boxes and cables racked on insulators. Separate utility closets on each floor contain surface-mounted lighting panelboards having common feeder junctions and tap boxes in the center. Concentric cabinet doors provide access to switches alone or to switches and fuses. Screwed steel trim covers the surrounding wire-free 5-inch gutters.

#### Controlled Operation

Unnecessary and extravagant use of light, heat, water and personnel super-

vision is reduced to a minimum through the use of automatic controls and remote magnetic switches. Time switches automatically control lighting in main floor show windows. Thermostatic controls regulate house tank temperatures and the operation of unit heaters, fans and circulating pumps. Remote magnetic switches activate motors located in inconvenient or remote parts of the building. Wherever practical, the operation of the store has been placed on either an automatic or supervisory basis, improving plant efficiency, safety and economy while reducing the manual routines requiring the attention of maintenance and engineering personnel.

Lighting panels on all merchandising floors are divided into three sec-



tions to provide separate control of floor and display case lighting, general ceiling lighting and night lighting. Current is conserved by cutting off, from the basement switchboard, incandescent illumination, local displays and sales counter equipment (time stamps, cash registers) at the close of the sales day. Cleaning and other after-hours activities are performed under fluorescent lighting, thereby utilizing lamps having greater life and less current consumption.

Another control is over the unauthorized use of fire-tower exits. These exits are guarded by wall-recessed photo-electric cells and light sources emitting infra-red beams. A warning bell, relay activated, is sounded when a beam is interrupted by the passage of any person. Unauthorized persons using the stairways are not conscious

of the invisible beams and, due to an arrangement of reflecting mirrors in both walls, it is impossible to pass the warning station without interrupting the continuity of light between source and cell.

#### Illumination Plan

In designing the lighting plan, consideration was directed to the varied purposes and illumination requirements of sales areas, business office space, clothing alterations department, storage and building service areas. Further attention, to type of light source, application and intensity, was required in merchandising areas displaying such diversified materials as clothing, jewelry, furs and leather ac-

cessories. Particular attention was given to create environments best suited to merchandising. The competition of natural daylight has been virtually eliminated in merchandising areas, and all air conditioning, sprinklers, architectural details and decorations have been coordinated to assure pleasing as well as effective results. Wattage of lamps, installation details and fixture designs were determined by mounting heights, available recessing space, effects and illumination intensities desired. Color consideration was given to lamps and reflectors as well as to wall treatments and carpeting in order to achieve harmony in decoration, to minimize color distortion, present merchandise most favorably and to flatter skin tones of shoppers. White surfaces are warmed by the restrained addition of pink tints.

Applications range in degree from

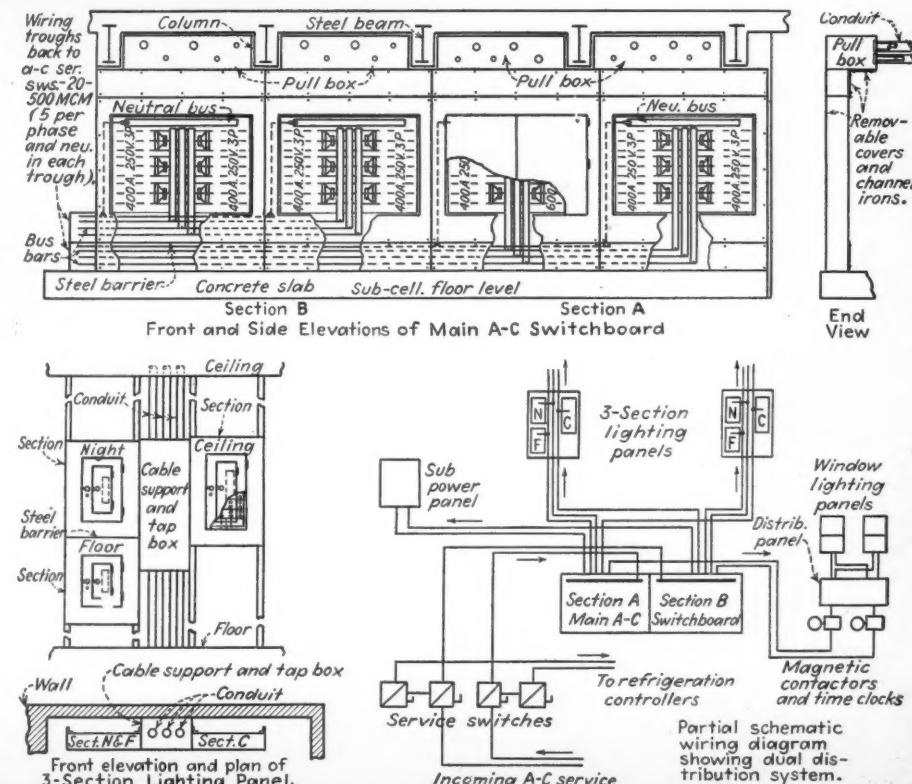
totally indirect to totally direct. Lenses, louvres and diffusing panels are employed to achieve light concentration or dispersion, resulting in a lighting plan that answers the requirements for general illumination, functional concentrations and decorative treatments.

The design of the new Lane Bryant store was created by architects Ely Jacques Kahn and Robert Allen Jacobs in conjunction with Edward E. Ashley, the electrical and mechanical consulting engineer for the project. The electrical installation and d-c alteration was handled by the Janover Electric Company. The Taylor Construction Company was the general contractor. All firms employed in the renovation program are located in New York City.



*Sportswear is displayed by narrow case and inbuilt fluorescent strip lighting, recessed incandescents above ceiling-flush distributing lenses, and multi-source general illumination.*

**Dual distribution system begins at utility service entrance and extends through entire store area, guaranteeing uninterrupted service. Efficiency and economy are obtained through use of three-section lighting panels and extensive use of automatic controls.**



# LABOR COST VARIABLES . . .

**Estimating electrical construction labor costs involves appraisal of many variables calling for close analysis and experienced judgment.**

**S**O vast are the variations in labor costs for electrical work that only they who have a natural propensity for analyzing conditions and are constantly engaged in electrical construction work can prepare sound estimates. It would be impossible to relate all the influences which enter into labor costs; however, some factors are outstanding. Before pricing the labor on any project, the three following major factors must be considered.

- (1) The type of project
- (2) The working conditions
- (3) The labor market

All three of these factors enter into the labor cost of any job and in some cases their effects are so interwoven that it is hard to determine how much any one will influence the final cost.

As a general classification, contractors engaged in building construction work speak of work as being residential, commercial, institutional, industrial, or special. Each of these in turn embraces several individual types. A partial listing follows:

#### RESIDENTIAL

Speculative Houses  
High Class Residences  
Apartment Buildings

#### COMMERCIAL

Small Stores  
Department Stores  
Theatres  
Office Buildings

#### INSTITUTIONAL

Schools  
Hospitals  
Asylums

#### INDUSTRIAL

Factories  
Power Plants  
Power Houses

#### SPECIAL

Sewage Disposal Plants  
Water Works  
Recreation Centers  
Mines

Considering that any one of the foregoing types has its individual characteristics, it can be readily understood why we repeatedly point out that it is futile to try to set up any tables of labor units which are universally applicable.

A four inch square switch outlet box will have a labor unit of 0.20 to 0.30 hours for a speculative house, whereas the same box will have a unit of 1.25 to 1.50 hours when installed in the column of a heavily reinforced concrete building. Conduit and boxes installed on a 16 ft. ceiling will have labor costs approximately 20 percent greater than those for a 12 ft. ceiling. One could go on indefinitely sighting such variations which are a result of types of construction. As shown by

the foregoing list, working conditions and the labor market also have to be reckoned with.

#### Working Conditions

One of the biggest gambles in contracting is the possibility of having good working conditions. On new building construction projects, one does not always know who the general contractor will be, what sub-contractors will be engaged, and other pertinent factors which would enable him to anticipate job conditions. That is why industrial contracts for complete installations (jobs where the contractor furnishes all the materials along with the installation service) are generally among the best risks. On such projects there is less likelihood of unforeseen interference from other trades.

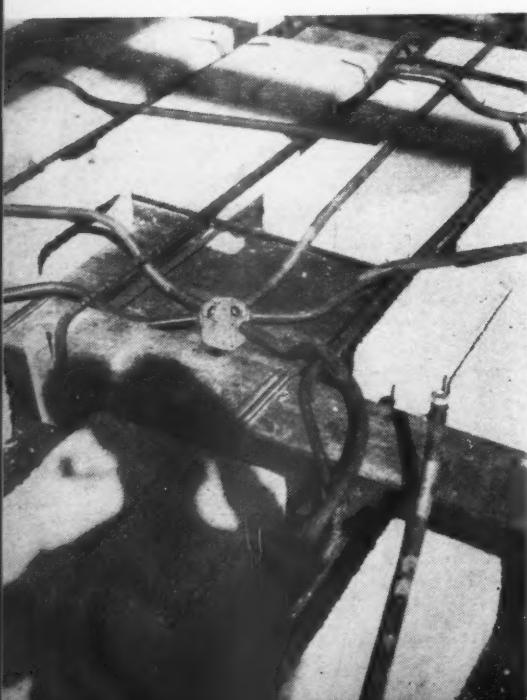
The following are a few of the many things to be considered:

- (1) Proper selection and timely delivery of materials
- (2) Progress of the job as a whole
- (3) Conditions of working spaces
- (4) Tools and equipment
- (5) Cooperation of other trades
- (6) Weather conditions

#### (1) Proper Selection and Timely Delivery of Materials

"The right materials, in the right quantities, at the right time" constitutes one of the cardinal rules of good construction practice. Recent experience on "Installation-Only Projects," figures show how direct labor may be increased as much as 10 percent if this rule is not adhered to. The effects of procurement failures and untimely deliveries are equally bad on both "Complete Installations" and "Installation-Only Projects." The last year has been one of constant struggle to get deliveries on time. With suitable materials and equipment hard to

*Installation and layout costs run higher on this type of installation than for flat slab construction.*



# Part I

By Ray Ashley

locate, and deliveries erratic, construction programs have been irregular and hectic. Such conditions are always reflected in direct labor costs.

Each construction trade is affected directly and indirectly by such conditions; directly, because its own schedules are irregular, and indirectly, because other trades have the same troubles and are unable to offer normal cooperation.

## (2) Progress of the Job as a Whole

Completeness of plans and specifications, general supervision, contractors, and coordination of trades, all enter into the general progress of a job. Best results are realized when competent architects and engineers have complete control of the work. Contractors are carefully selected, the work well timed, and trades properly coordinated.

Any irregularity in the construction program is likely to be noticeable in direct labor costs. The electrical contractor has men and equipment on the job to meet a certain construction schedule. If the schedule is not maintained, there is lost motion, and the men have to either mark time or be shifted to another job. Another project may move too rapidly to permit a contractor to use his men and tools to the best advantage, or it may go by spurts and create fluctuating demands. Fluctuations increase labor costs on the particular work and the job which temporarily relieved the men also suffers a loss.

Making allowances for job progress is largely speculative; however, there are many ways in which the estimator builds up his case. It is a part of the estimator's business to be familiar with the reputations and records of architects and builders. He knows with what care they select contractors, how well their jobs are superintended,

TYPE OF INSTALLATION		CONDUIT		OUTLETS	
		Hours/100 Ft.	Hours Each	Hours Each	Hours Each
Exposed on Wood	12 Ft. Ceil.—K. O. Box	5.5	6.0	0.7	0.65
Exposed on Wood	16 Ft. Ceil.—K. O. Box	6.5	7.2	0.85	0.65
Exposed on Concrete	12 Ft. Ceil.—K. O. Box				
(1) Fastenings not included		6.	6.5	0.75	0.7
(2) Fastenings included		8.	8.5	0.95	0.9
Exposed on Concrete	16 Ft. Ceil.—K. O. Box				
(1) Fastenings not included		7.2	7.8	0.9	0.75
(2) Fastenings included		9.2	9.8	1.1	0.95
Exposed on Concrete	12 Ft. Ceil. Hub Ftgs.				
(1) Fastenings not included		6.2	6.7	1.1	1.0
(2) Fastenings included		8.2	8.7	1.3	1.2
Exposed on Concrete	16 Ft. Ceil. Hub Ftgs.				
(1) Fastenings not included		7.5	8.0	1.3	1.0
(2) Fastenings included		10.	10.5	1.55	1.2
Concealed in Slab—Thin Slab Constr.		5.	5.25	0.8	1.4
Concealed in Slab—Heavy Slab Constr.		6.	6.5	1.	1.5
Exposed on Steel	16 Ft. Ceil. Hub Ftgs.				
(1) Fastenings not included		7.5	8.	1.4	1.1
(2) Fastenings included		10.	10.5	1.65	1.35

*Experienced labor costs on a very limited number of construction types. Such tables cannot embrace a great variety of types and conditions. At best any table of labor units is only useful as a guide.*

and what success they have in coordinating the work of all trades.

In normal times certain architects follow a particular line of building and they know which contractors can best produce the results they want. Contractors are selected who can do their own work well and at the same time cooperate with other trades to work for the best interests of the job as a whole. Often the same group of contractors go from job to job and they become so accustomed to working together that the progress made is beneficial to all concerned.

With such smooth running work direct labor cost, supervision, operating costs, and overhead are all held down to a minimum. Benefits are not limited to the contractors only. Architects and owners also profit by expeditious work of contractors. The architect is able to close the job in a reasonable length of time and his costs of superintending are low. The owner in turn has his job delivered on scheduled time and does not have his money tied in a project which is being delayed by poor management on the part of the architect and the trades involved.

## (3) Condition of Working Spaces

Condition of working spaces can be roughly classed under three headings:

- (a) Construction spaces
- (b) Floor conditions
- (c) Air conditions

### (a) Construction Spaces

The jams that an estimator can get into by not knowing how cramped and unfavorable working conditions are going to be, are really tragic. To avoid such jams one must be constantly alert, as the plans which indicate the best provisions for electrical work are often those for jobs of the worst sort. The more congested the work, the greater the likelihood of each mechanical trade being drawn up separately. The individual plans make the work look simple, but when superimposed the combined trades present quite a different picture.

The writer had occasion recently to plan an estimating schedule for a large research building. Looking at the electrical plans led one to believe that it would be a prize installation. A study of all mechanical plans, however, revealed that the electrical installation



**Time required for installing ceiling outlets in flat slab construction is much less than for many other types of buildings.**

would be nothing short of a nightmare. The basement plan showed numerous large feeder conduits run on the main corridor ceiling. To have installed the work as shown, would have been simple. Other plans, however, had work in the same space. There were gas, air, steam, and water pipes, all to go in this corridor with the feeder conduits. Similar congested spaces were in evidence elsewhere.

Electricians working on such a project have plenty of trouble. They must work to close measurements, in cramped spaces, and provide numerous offsets and pull boxes in order to clear other work. In addition, there are the difficulties which always result from several trades trying to work in the same location.

Limited riser shafts always warrant careful study. It is one thing to succeed in crowding riser conduits into a shaft, but getting them in in such a manner that they can be brought out at the proper floor, is quite another. The arrangement of horizontal runs, does not always lend itself well for adaptation to the vertical arrangement which is more or less fixed. Offsets or pull boxes used to overcome such difficulties consume much time. In addition there is the extra labor which always accumulates when men are working in crowded spaces.

#### (b) Floor Conditions

Contractors try to plan their work so they can take advantage of the

best floor conditions. It seldom occurs that ideal conditions exist, and very often it becomes necessary to cope with numerous obstacles.

Occasions arise where part of the work must be installed while the floors are still in an unfinished state. This is often true on industrial projects where the buildings are one story steel structures. In order to meet time limits of the contract, the electrical work is started as soon as the steel is up and the roof on. The ground may be levelled off or it may present a series of pipe trenches and mounds of excavated dirt. Such conditions prohibit the use of rolling scaffolds and greatly interfere with ladder work.

In buildings with finished floors, there are possibilities of much interference from materials and operating equipment. Such obstacles are many and varied. Existing plants, which are operating, usually offer many risks. Moving machinery, hand trucks, stock piles, and factory workmen, are all hazards.

Installations in new buildings may prove to be as difficult as those in existing plants. Take, for example, a bottling plant being rushed to completion. At the time motor wiring is being installed, the floors will be packed with equipment and workmen of the various trades. Sterilizers, bottling machines, coolers, lablers, conveyors, and other pieces of equipment are all packed together with mechanics working on one or all of them.

If one is figuring work which is to go in an existing building, he should by all means take a look at the conditions. On the other hand, if he is figuring work for a new industrial plant, he should try to acquaint himself with conditions in similar plants.

#### (c) Air Conditions

Troubles from gases, fumes, and excessive heat, are experienced only on occasional projects. Unfortunately, (because they are not every-day occurrences) estimators sometimes overlook such possible trouble.

One may be figuring the work for a new plant, but he can never be sure that he will have men out before operations start. Part of the plant may be rushed to completion and operations started before the remainder of the plant is ready. Under normal conditions the electrical contractor seldom gets out of industrial plants until long after production is under way.

Work near ceilings or roofs may be extremely costly in gas plants, furnace rooms or any place where the air is not normal.

The above conditions all affect in one way or another the cost of labor on the job. They cannot be analyzed from tables of labor units. They must be appraised from training and experience. The next article in this series will discuss other and equally important factors which must be considered in accurate job estimating and cost analysis.

# TELEVISION ANTENNA SYSTEMS

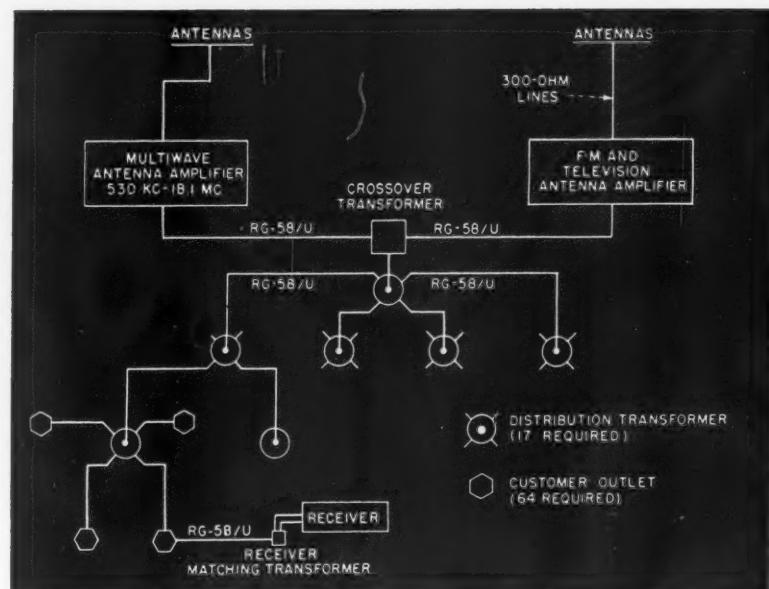
**Reception for apartment dwellers depends upon group antennas, coaxial transmission lines and special outlets.**

TELEVISION reception requires a well designed and properly located antenna. The high frequencies used in television travel in straight lines. They reflect from solid objects. Since television sets cannot discriminate between direct and reflected waves, the antenna must be designed 1) to receive and transmit to the set a signal of adequate strength and 2) to discriminate by directional characteristics against reflected signals.

Ordinary radio broadcast frequencies (550 to 1500 kilocycles) readily penetrate building walls so that sensitive preamplifiers and small built-in loop antennas can give quite satisfactory reception. The days of a forest of antennas on apartment house roofs are long past, but in real estate circles the memory lingers. Apartment house management in New York and Chicago have already banned the erection of television antennas. They have advised their tenants against the purchase of television sets until satisfactory antenna systems are available to serve groups of sets.

Even without the ban, the erection of several antennas in close proximity causes interaction and interference which can seriously impair reception.

The future of television in the great



*Antennaplex distribution system for 64 outlets providing broadcast, shortwave, television and FM signals over a single cable. System can be extended to 256 outlets without additional amplifier equipment.*

urban centers depends upon the development and installation of proper and effective antenna systems in apartment buildings. The development and installation of antenna systems on the other hand depends upon the public demand for television sets. Aggravating the impasse is the current sellers market in apartment rentals. Apartment house owners are unwilling to provide new and expensive tenant services.

The break should logically come in new apartments under construction. That FM radio and television will become as common as broadcast radio during the early life span of these buildings is axiomatic. However, few now under construction have raceways suitable for high frequency radio transmission lines. On one New York project, a raceway system originally planned was actually omitted under an alternate as an economy measure.

Contributing to the confusion is the practically complete blackout of technical information outside of the television laboratories. The presumption that factory trained servicemen will install television sets and the necessary antennas and transmission lines when the set is purchased may be satisfactory for detached homes or small

multiple occupancy buildings. The group antennas, the preamplifier, the transmission lines, the outlets and the raceway systems necessary for apartment houses, however, are not related to the sale of individual television sets. There is, therefore, an urgent need for getting necessary technical data out to architects, engineers, electrical contractors and real estate owners, who have otherwise no concern with the manufacture, sale or installation of television sets.

## Antenna Systems

A study made by the editors of *Electronics* describes several antenna systems now available or soon to be available; they include those developed by the consulting firm of Amy, Aceves and King, the Radio Corporation of America, the Telecon Corporation and the United States Television Corporation.

The first two firms have for many years designed and installed master antenna systems for broadcast and short wave services. By 1941, systems of this general type were installed in over 1200 new buildings and about 1000 existing buildings. Costs ran about

[Continued on page 172]

# Wiring a MEDICAL CLINIC

Anesthetics and special requirements call for specialized wiring methods and equipment.

By M. N. Shansby,  
Supervising Electrician  
El Serco, Los Angeles, Calif.

**W**E have recently completed the wiring installation of a small clinical building for Dr. Walter Wakelin at 5306 No. Figueroa St., Los Angeles, said to be as up-to-date as anything doctors can conceive to help them in diagnosis and treatment. Since such clinical units are apparently on the increase, our experience on the special requirements of such work may prove useful to others.

This clinic building is only 36 ft. 6 in. wide by 46 ft. long, yet it contains 17 rooms. Nothing but the architect's floor plans were available—no electrical wiring diagrams of any sort. The electrical contractor was supposed to figure out all the necessary circuits, after consultation with the doctor-owner of the clinic as to the equipment and lighting facilities to be installed. The entire installation was to be as adequate, convenient and as nearly foolproof in every way as the most modern ideas and materials would enable us to make it.

The final layout required more wiring and wiring devices than we ever put into a like number of cubic feet of space. In carrying out the idea shown in the diagram, here are some of the major problems encountered.

All receptacles, switches and the whole air intake and exhaust system in the surgery were to be explosion-proof.

All six of the general lights in the surgery were to be vapor proof. When it came to the surgical lamp, this was connected so as to set in operation the



*Into this relatively small building, used for a doctor's clinic, were crammed more wiring and wiring devices than would ordinarily be found in other types of buildings several times as large.*

motor of the exhaust fan for that room, with the turning on of the lamp. The air in a surgery must be changed at least twelve times per hour during an operation. Since the operation would never be performed without the lamp on, the safe, foolproof way would be to start the exhaust automatically with the turning of the lamp switch.

Altogether, the surgery, which is only 16 ft. by 17 ft., contains six vapor proof fixtures, two explosion-proof receptacles, two explosion-proof switches, one surgical lamp and one complete grounding system to guard against static electricity igniting any combustible substance that may escape into the room during anesthetization, which will be described later.

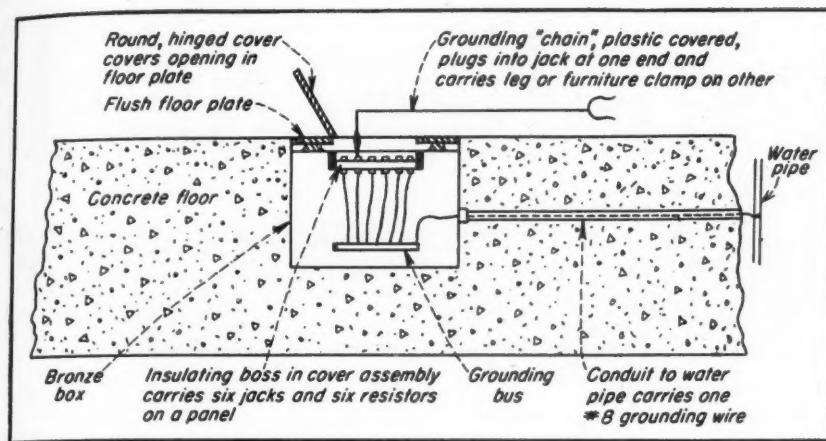
Throughout the surgery, asbestos covered heat resistant wire was used, in the ceiling. This was beyond requirements, but it makes a better job, with less danger from deterioration.

The exhaust system for the surgery is a separate unit. This is also beyond

requirements, but was done so that there could be no possibility of explosive fumes reaching any other part of the building. This is not a new idea, but one that was strongly advocated by us. A separate fan is used to ventilate all other parts of the building, on a separate duct system.

As to the grounding system in the surgery, the danger of explosion from static electricity has long been recognized by medical people, fire prevention boards and the Underwriters' Laboratories. Various methods have been used to ground all equipment, the patient and the surgeon. We chose a system that is comparatively new, is safe, not unduly expensive and could be installed like any other wiring and not built into the structure except for a short run of pipe in the floor. It is the hospital electrostatic grounding inter-coupler, made by the Cannon Electric Development Co., of Los Angeles.

It consists of a square, bronze floor



Diagrammatic sketch showing the grounding system employed to prevent static sparks in the surgery.

of the partitions are fire resistant, two inches thick, solid plaster.

Because of the thinness of the plaster partitions, we used some switch boxes that had been cut down to  $1\frac{1}{2}$  inches in depth. After the box hanger and switch ring were installed we had exactly  $\frac{1}{16}$  in. to spare in locating each box. This made the mounting of these boxes really a precision job. The tubing had to be bent perfectly so as not to pull the boxes even the slightest fraction out of position.

In the surgery and halls, for general lighting, glass-enclosed, two-lamp 20-watt, recessed fluorescent fixtures were employed. All other general lighting is cold cathode. Ceiling outlets in all rooms except the surgery were wired on one side of the room. This was done so that the eight-foot length of cold cathode fixtures would be located in the center of each room.

The completed installation is an excellent example of concentrated wiring.

box with a circular hole in the top on which is mounted a cover assembly through a watertight gasketed connection. A circular boss on the underside of the cover assembly has a sealing gasket, which allows an alignment of the assembly in case the box is not set exactly horizontal.

The circular boss is equipped with an insulating panel which is provided with six jacks arranged in a circle and approximately flush with the panel. On the underside of the panel are mounted six corresponding  $\frac{1}{2}$  megohm resistors one side of each connected to the corresponding jack and the other to a common ground connection with the ground jumper to the grounding bus in the bottom of the box.

The box, usually located under the operating table, is set in the concrete of the floor sufficiently below the surface so that the top of the cover assembly, or floor plate, is flush with the floor. In the middle of the floor plate is a circular, hinged cover giving access to the jacks. This cover is also provided with a sealing gasket.

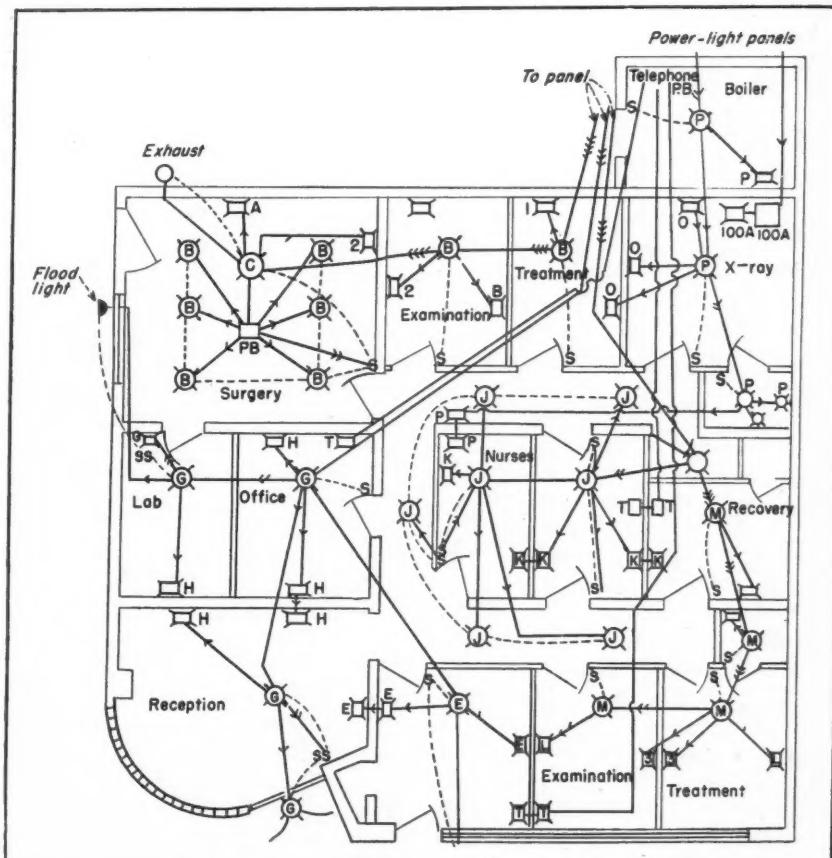
A conduit, laid in the floor concrete is led from the box to the nearest water pipe, to carry a No. 8 grounding wire from the grounding bus and connected to the water pipe with a clamp.

What are called grounding chains are provided with a plug at one end to enter the jack and a clamp at the other to clamp onto a person's leg or to furniture or equipment. The chains are beaded and covered with transparent plastic, very neat looking and light and flexible. Two chains 6 ft. long, with 1-in. clips are provided for the anesthetic machine and the hot water table; two chains 4 ft. long for the surgeon and patient; one for the anesthetist, and one for clamping on the exposed metal tubing of the operating or instrument table.

Because there is no attic in the

building, we were unable to use pull boxes, which necessitated more home runs than in the average installation. In addition, we had to make five  $\frac{3}{4}$ -in. line home runs for telephone service, to a central panel in the boiler room, located in a small, attached building.

One especially vexatious problem arose from the fact that all the outside walls and some of the partitions are of hollow concrete blocks (this is a class A building and constructed to accommodate a second story later). The rest



Electrical wiring diagram for the clinic. Building 36 $\frac{1}{2}$  ft. by 46 ft., one story; 100 ft. of 1-in. conduit; 400 ft. of half inch conduit; 1100 ft. of steel tube,  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and 1 in.; 5,400 ft. of wire; \$2200 worth of lighting fixtures.

# Footcandles SELL



Show window and arcade ceiling fixtures are duplicated in accessories area. Continuous bank of recessed luminous ceiling panels separate accessories area from main sales salon.



Sunken, carpeted shoe salon is primarily lighted by two-lamp fluorescent troffers, combined into units by the use of building molding as framing around each double run. Different color treatment inside and outside framed areas further unifies the treatment. Natural white oak, light grey and deep red give richness to walls and warmth to furniture.

**I**N a modern design that demonstrates the dramatic possibilities of utilizing planned lighting and wiring as essential architectural and building instruments, a new John Ward shoe store in metropolitan New York employs fluorescent, incandescent and cold cathode lighting to effectively illuminate both merchandise and the rich setting of selected woods, fabrics, metals, stone, glass and paints.

Separate areas of the store are smoothly integrated by the skillful continuity of lighting and architectural motifs between departments. Entrance ceiling patterns and show window treatments are carried through an all-glass front wall from the accessories area to the exterior arcade, the honey-colored pine ceiling then sweeping upwards at the building line to form an attractive backing for illuminated bronze letters spelling the firm name across the facade. Sign lettering is outlined in white by double rows of cold cathode tubing. Transformers are mounted behind the pine backing with access panels located above.

The entrance and accessories ceiling is pierced by eight flush, 30-inch square, diffusing glass panels, four

located on either side of the all-glass store front. Each panel is evenly back-lighted by three 20-watt 4500-degree fluorescent lamps mounted 6 inches above the panel line in a recessed metal box fixture.

Two large show windows flank the arcade while a smaller display area faces the street. The display case on the left, of cantilever construction, paneled in oak and extending through the glass front to the shop proper, is lighted by three illuminating media; a row of recessed 150-watt R40's behind ceiling-flush disc louvres on 24-inch centers, a series of 150-watt spots in bell-shaped spun-metal reflectors suspended with pivots 13 inches below the ceiling line on 34-inch centers, and three continuous rows of 4500-degree fluorescent lamps (40-watt mounted end-to-end) in troffers recessed across the rear ceiling. The recessed right show window, displaying specialty merchandise, is illuminated from above by four continuous rows of 40-watt fluorescents mounted between 8 inch deep wooden louvres, and a row of 150-watt incandescent reflector-spots, recessed in inclined sockets located behind the upper frame of the case. The

small bronze-framed window at the street end of this display area is top lighted from above by a single 20-watt fluorescent lamp and one 150-watt R40 spot.

The all-glass front serves as yet another displaying means, presenting the entire interior to the public. From the arcade, pedestrians can view the accessories area immediately inside the Herculite glass doors, the sunken sales area, bordering stock racks and interior wall displays.

Hosiery racks, in the accessories area, are lighted both by suspended bell-shaped spots and ceiling-recessed fluorescent fixtures. The remainder of the store is lighted exclusively by fluorescent lamps. Open-faced white-oak shoe racks along the left wall are top lighted by a shielded single continuous border of 40-watt whites. Reserve stock, in library racks placed at an angle with the right wall and behind the curved rear partition, are illuminated by multiple two-lamp 40-watt 4500-degree surface-mounted fixtures. Wall displays, set into this curved rear partition, are top lighted (single 24-inch whites), and small shadow box displays facing the interior building

# Footwear

Modern design, engineering and installation of lighting plan contribute to successful merchandising in shoe store.

halls are top-lit by single lamps.

The ceiling treatment of the main sales area utilizes two illuminating designs; an unbroken row of seven square units recessed above the interior limit of the accessories area, and three large recessed panels on 10.5 foot centers that traverse the area. The luminous squares duplicate those installed in the arcade ceiling. The transverse panels are formed by two parallel runs of two-lamp troffers on three-foot centers and faced by diffusing glass panels. Forming each twin-troffer unit into a unified assembly is

accomplished by framing troffers with molding and painting the area inside this frame with a flat white to create a pleasing contrast with the remainder of the pearl grey ceiling.

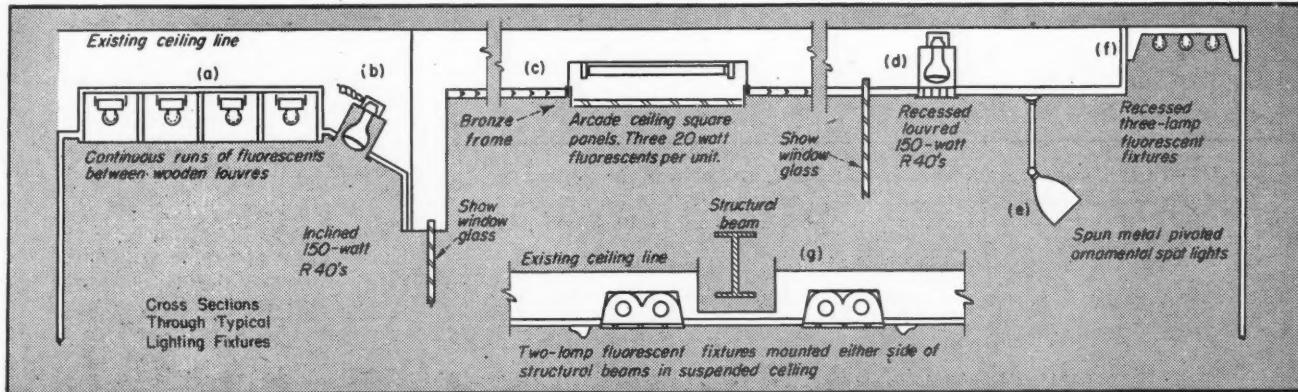
The electrical panelboard, metering equipment, air conditioning unit and time switches for the exterior sign and window lighting are located in a small service room in the rear of the store. Variety in lighting is achieved through the multiplicity of circuits which segregate the store into functional areas and group the luminaires into units of similar design.

The physical treatment of the store combines a red brick and grey stone exterior with interior wall treatments of natural white oak, brick red and light grey painted surfaces. Carpeting is a dusty green while custom-built furniture is upholstered in deep red brown leather.

The design was created by J. Von der Lancken, architect, Raymond Loewy Associates. The electrical installation was by Mulliken and Dietrich. Fluorescent fixtures were manufactured by Curtis Lighting; display spotlights by General Lighting Co.

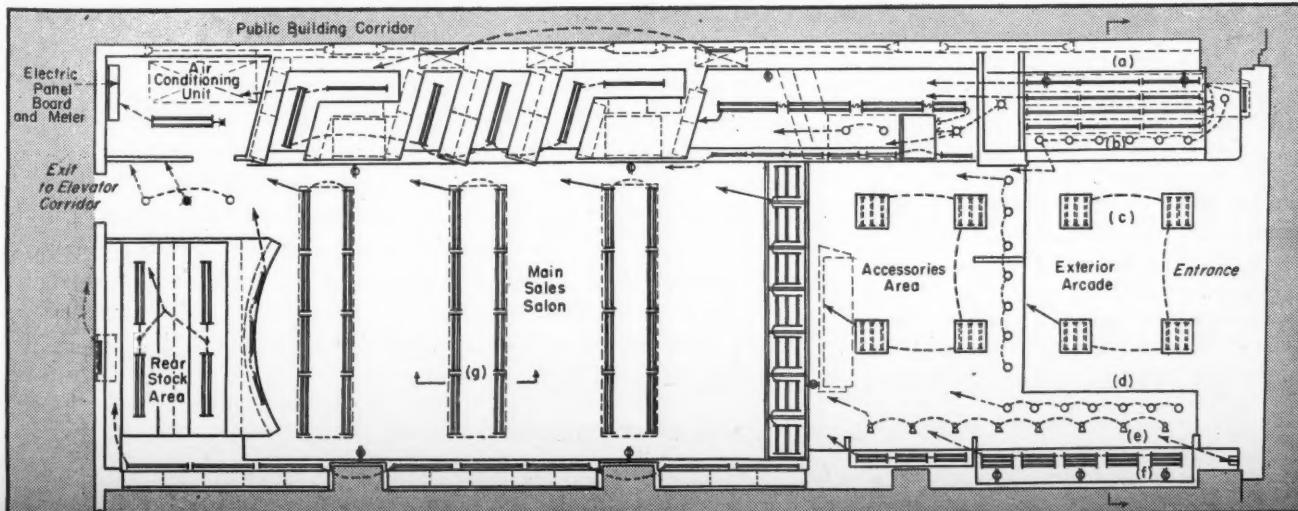


Luminous panel pattern in arcade ceiling and treatment of left show window continue through all-glass front to accessories area.



The selection and location of both decorative and functional illumination emphasizes the appeal created through planned lighting. Architecture, lighting and interior decorations are harmoniously blended.

John Ward shoe store utilizes incandescent, fluorescent and cold cathode lighting in show windows, exterior treatment of arcade and interior illumination plan to effectively attract attention and promote sales.



# INDUSTRIAL LIGHTING

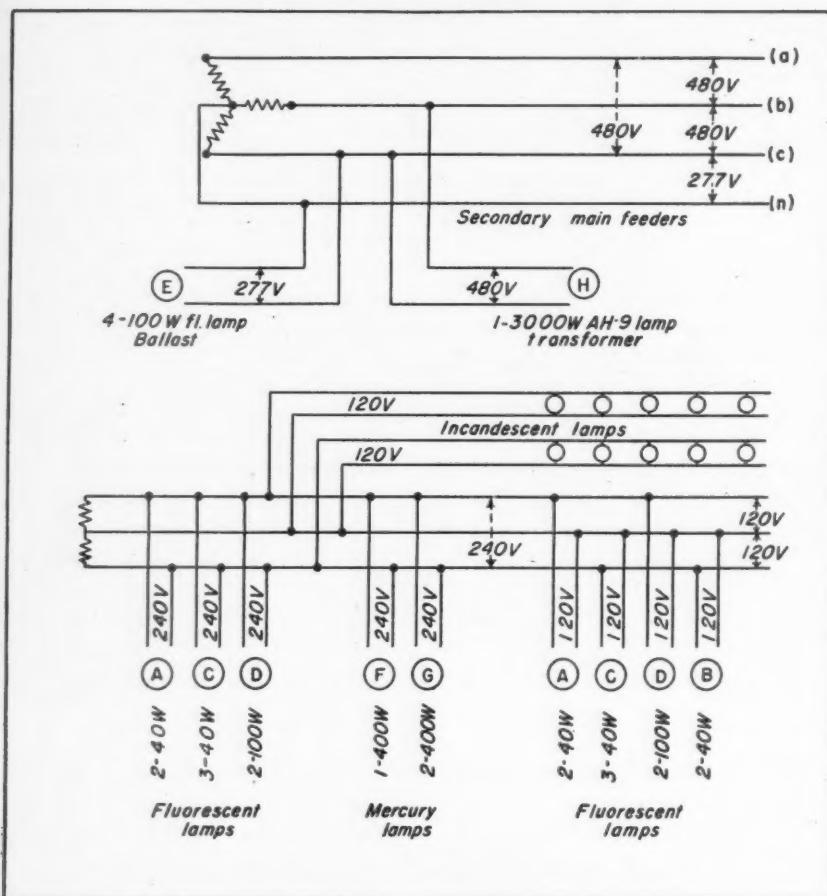


Fig. 1—Top wiring diagram shows typical 277/480 volt, 3-phase four-wire Y-connected distribution system. Lower wiring diagram shows typical 120/240 volt single phase three-wire system, available from single phase of the 480 volt 3-phase system.

SATISFACTORY operation of any lighting system depends on adequate wiring and a flexible electrical distribution system. Proper voltages must be maintained. Power factor must be kept as near unity as possible. Electrical energy should be distributed economically, but not at the expense of adequacy. The secondary distribution system should be flexible, to permit utilization changes, or type of lighting, with minimum changes in the wiring system itself.

All electrical installations must be made in conformity with the requirements of the National Electrical Code and local ordinances. The function of the Code and local ordinances is to provide safety against fire damages and personal hazards. It relates to *installation* of electric wiring, not to *design* procedure or practice. It should not,

therefore, be used as a criterion of an adequate or efficient wiring system, as it is possible to install an inadequate wiring system in complete conformity with the Code.

There are, of course, limiting factors on the selection of an electrical dis-

## How to select a flexible and economical wiring

tribution system for any proposed lighting layout. The size of the plant is one such factor. Small plants are usually limited to the type of service available from the local electric utility lines, or from their own generating equipment. Use of power for motors or heating loads will also affect the type of electric service available for lighting. Large plants, or plants with high load demands, will usually have more freedom in selection of secondary service. In many large plants power is purchased at high voltage and converted to desirable secondary distribution through a plant-owned substation. In these plants it is possible to select almost any voltage or combination of voltages and phases for secondary distribution which will best serve the plant as a whole, including the lighting load.

Direct current systems are more expensive than alternating current systems, and are steadily being replaced. For this reason, d-c systems will not be considered here.

Some of the more desirable general service distribution systems for lighting loads are listed in Table I. Single-phase lines are primarily used for lighting branch circuits, with 120 volt service being almost universal. It will be noted that Table I lists voltages in the 120-240-480 volt series only. Voltages in the 110 and 115 volt series are being superseded for lighting requirements for economic and other reasons. Incandescent lamps

## INDUSTRIAL LIGHTING TECHNIQUES

This article completes the series on *Industrial Lighting Techniques*. Covering wiring principles and practices, it has been included in order to round out information needed in the design of a well planned and economical lighting system. Much of the information relates to auxiliary ballasts and transformers for fluorescent and mercury vapor lighting. Consideration of these auxiliaries now becomes important, along with lighting equipment, light sources, and the electrical distribution system itself. This brief round-up should therefore be of value to lighting engineers and all others who plan industrial lighting.—Editor.

# TECHNIQUES

## system for a proposed lighting layout.

rated at 120 volts are generally available in stock, with other voltage ratings being considered special more and more. Ballasts for fluorescent lamps and transformers for mercury vapor lamps are designed for maximum performance on 120-208-240-277-480 volt systems, allowing for normal voltage drops in branch circuits up to two percent. Operation of incandescent lamps or electric discharge lamps at lower than rated voltages will reduce the light output considerably (Figs. 4, 5 and 6).

One factor seldom given proper consideration when planning wiring systems for lighting loads, or selection of the number and size of lamps to be operated by one ballast, is the power lost in ballasts and transformers. Fluorescent or mercury vapor lighting will be selected for the lighting layout, and then a 120-volt system is arbitrarily selected to supply the electrical energy. Lumens per watt, taking into account ballast or transformer efficiencies, vary over a wide range (Table II). For example, a 3-lamp 40-watt ballast, designed to operate on 208 volts (199-216 volt range) has a loss of 14 watts only, resulting in an efficiency of 51.5 lumens per watt when rated voltage is applied to the system. Use of a 2-lamp 100-watt ballast, designed for use on the 110-125 volt range (118 volts normal) results in 36.2 lumens per watt, or 68.4 percent efficiency, compared with the 3-40 watt lamp design operated at 208 volts.

Data in Table II are based on high power factor ballasts and transformers only. It is not all-inclusive of high power factor types. Power losses in low power factor auxiliaries (not listed) are even greater, resulting in less lumens per watt consumed. Study of this table will indicate that lighting engineers must of necessity give more consideration to wiring problems, if maximum efficiency of the

## Part IV— Wiring for Lighting By Berlon C. Cooper

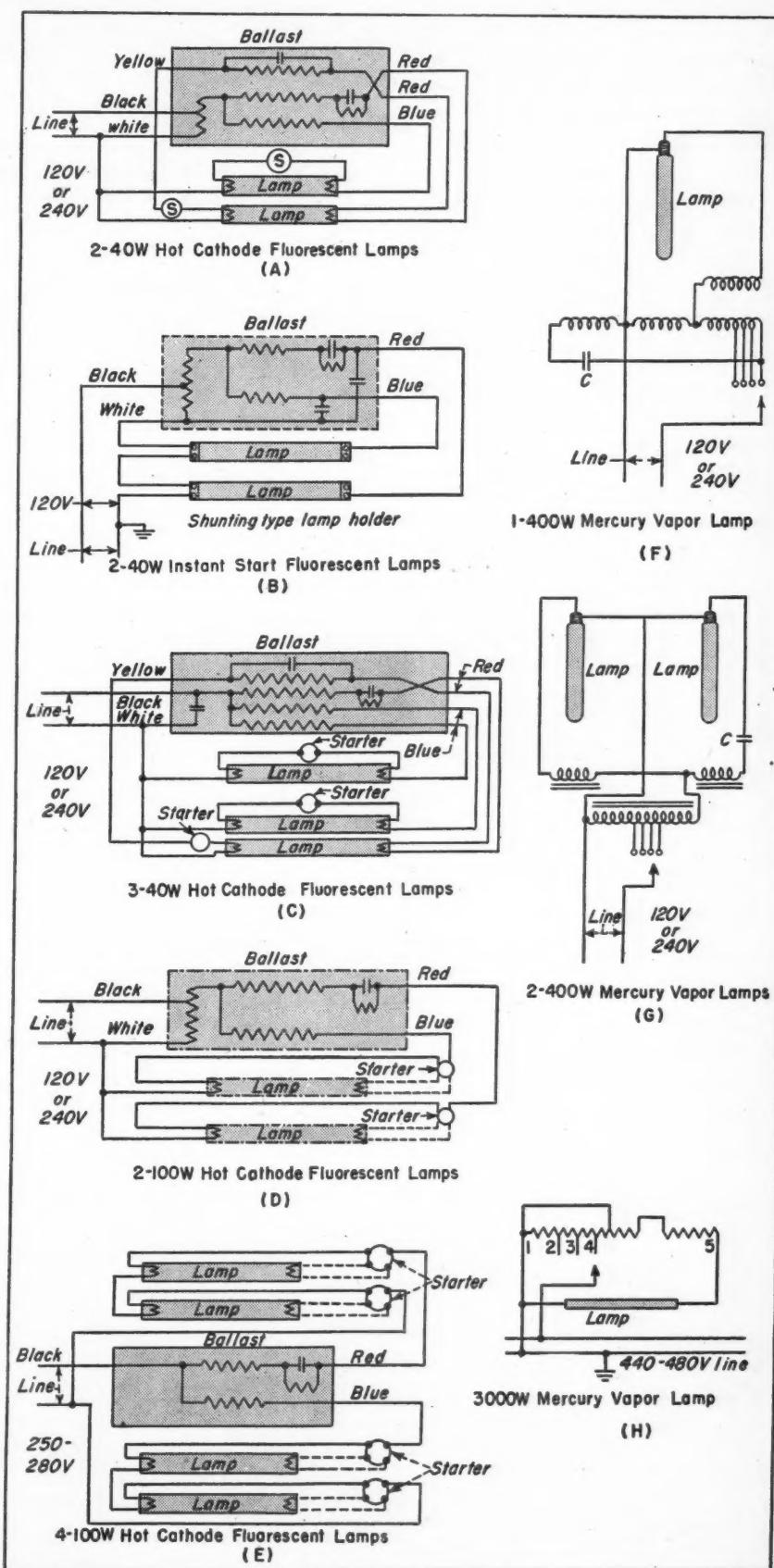


Fig. 2—Wiring diagrams showing connections of ballasts or transformers to line supply for popular types of units.

lighting system is to be achieved. Similar data for any light source, ballast, or transformer can be readily developed from technical data furnished on these items by their manufacturers.

Normal design procedure for lighting engineers is to first locate all lighting outlets and wattages on the floor plans of the areas to be lighted. These should include ceiling and other outlets for general lighting and emer-

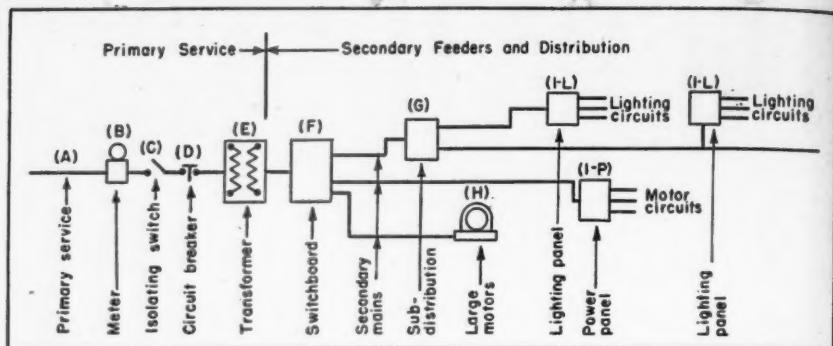


Fig. 3—In small industrial plants, primary service is furnished to the plant by the electric utility up to switchboard (E). In large industrial plants primary service (A) is furnished to an outdoor sub-station on customer's premises.

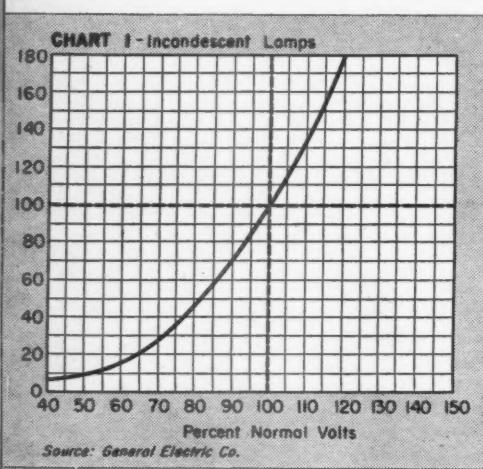


Fig. 4—Curve showing effect of operating large gas-filled incandescent lamps at other than rated voltage.

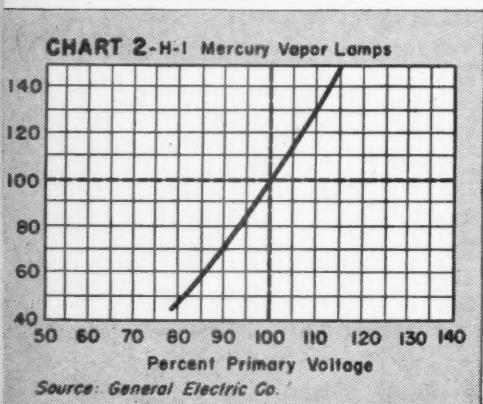


Fig. 5—Curve showing effect of operating a 400 watt type H-1 mercury vapor lamp with primary voltages varying from transformer tap setting.

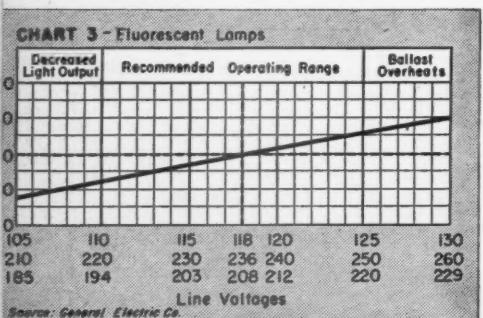


Fig. 6—Curve showing effect of voltage variations on light output of fluorescent lamps operated by 2-lamp ballast.

gency or exit lighting outlets. Switch outlets, when used, should also be shown. The lighting plans should also show all miscellaneous lighting outlets, such as aisle lights, yard lights, entrance lights, floodlighting for protection or advertising, signs, etc. Convenience outlets, except for motor loads or special frequency tools, are normally combined with lighting circuits, and should also be shown when they are to be included.

After the lighting and convenience outlets have been shown, the branch circuits and switch controls are indicated. Initial wattages per circuit should not exceed 60 percent of code requirements for branch circuits. This is based on consideration of voltage drop, copper loss and provision for future increase. Watts per square foot should also be computed and checked with wattage load tables of generally accepted good wiring practice (e.g., *Electrical Contracting*, September 1946, pp. 88-90).

Next step is to determine the number and location of branch circuit panelboards (Fig. 3, I-L). Overcurrent protection for each circuit is installed in the panelboard, and switch control when desirable. Panelboards should be placed where readily accessible and as near as possible to the center of the load they supply. No branch run from panelboard to first outlet should exceed 100 feet, and good practice dictates not over 42 branch circuits in one panelboard with at least one spare circuit for each five loaded circuits. At least one lighting panelboard per active floor is necessary. Location should also be such that feeders are as short as possible and have a minimum of bends and offsets.

Feeder distribution centers (Fig. 3, F, G) with feeder protection and

control of individual feeders are next located at convenient points so that feeder runs to panelboards are a minimum. Motor or other heavy power loads are also normally fed from these distribution centers. Service conductors and equipment supply power to the distribution centers.

With the above components of a basic wiring system tentatively located and grouped, the next step is to make preliminary estimates of voltage drops, conductor sizes, etc., complete with costs, for each of three or four circuit arrangements. Systems which would be considered on this trial estimate basis include: 120/240 volt, single-phase, 3-wire; 120/208 3-phase, 4-wire; 277/480 volt, 3-phase, 4-wire (Fig. 1) with 120/240 volt single-phase 3-wire branches; and 240 volt 3-phase, 3-wire systems. If motors or other electrical equipment already owned by the plant to be lighted are also to be furnished power from the same system, they may influence the final selection of the electrical distribution system for the lighting load.

The use of busduct for heavy power  
[Continued on page 174]

TABLE I

Secondary Distribution Voltages  
from Standard A-C Systems

Voltage	Phases	No. Wires
120	1	2
208	1	2
240	1	2
480	1	2
120-240	1	3
120-240	2	5
240	2	3
240	2	4
120	3	3
120-208	3	4
208	3	3
240	3	3
480	3	3
277-480	3	4

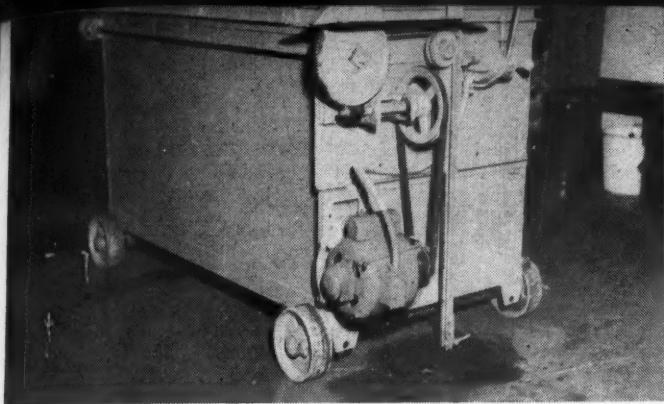


Fig. 1—Exterior of motor-operated dipping tank showing  $\frac{1}{4}$ -hp. motor, control, and rig for raising and lowering grilled elevator platform inside tank.

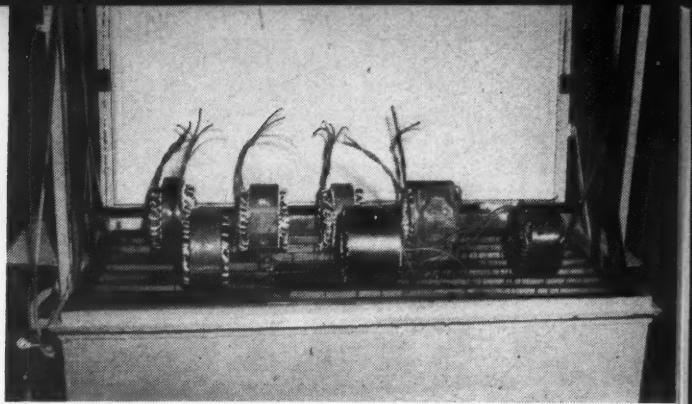


Fig. 2—Small stators placed on grilled elevator platform ready for dipping. Lead wires are left sticking up to prevent immersion.

# Dipping Stators

**Central Electric Co., Cambridge, Mass., designed and made a motor-operated dipping tank for small motor stators which saves labor and speeds up operations.**

CHRIS DULSEN, who owns and operates Central Electric Company, Cambridge, Mass., and specializes in repair of fractional and small horsepower motors, believes in labor saving devices, a clean shop, and an environment conducive to employee contentment. One of the labor savers, designed and made in his own shop, is a motor-operated dipping tank.

The tank, made portable by installing it on an oblong frame equipped with four wheels (Fig. 1) is welded inside and out. The inside dimensions are 44 inches long, 22 inches wide and 24 inches deep. It holds about 80 gallons of varnish. A hinged cover, used to keep the tank closed when not in use, is held upright by a ratchet while in operation. A grilled

elevator platform fits inside the tank. It is attached to greased slides, located on the outside of each end of the tank, by heavy steel straps. It is raised and lowered by two small steel cables on worm pulleys, one on each end of the tank, and connected at the back by a rod so that each end operates in unison. A  $\frac{1}{4}$  hp. reversible motor, welded in position on one end of the tank, powers the pulleys. The reversing switch is located near the top of the same end of the tank on which the motor is located, and permits the operator to raise or lower the elevator platform to any desired position. A safety device prevents the motor from running when the cover is closed.

The elevator platform will accommodate two 20 hp. stators, three 10

hp. stators, four 5 hp. stators, or about 16 fractional hp. stators at one time. When stators of approximately the same size are dipped at one time, they are placed on the platform and lowered just enough to cover the frames only, leaving the lead wires sticking up and out of the varnish. This eliminates the necessity for wiping the leads clean, and leaves the leads in their true colors and flexible after baking.

Daniel Nickerson, who assisted in the design of this tank and handles all dipping, preheats all stators before they are dipped. They are then placed on the grilled platform (Fig. 2), the switch is closed for lowering the platform, and the motor allowed to run until the varnish covers the top of the stators. They are left in this position until air bubbles stop rising to the surface, about ten minutes. Then the motor is turned on again to raise the platform and stators to the top of the tank, where they are left to drip for a few minutes. The only wiping necessary to be done is the inside of the core only. Small stators are then lifted off the platform (Fig. 3) and placed on the oven rack (Fig. 4) which rolls in and out of the electric bake oven. Heavy stators are lifted from the dipping tank to the overhead electric hoist.

Fig. 3—Daniel Nickerson removes stators from platform after dipping operation. Tops of stators are immersed about one inch below varnish level in tank.

Fig. 4—Stators are moved from dipping tank onto rolling platform at end of tank and pushed into the electric baking oven.



BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

# Practical Methods

## Envelope Salesmanship

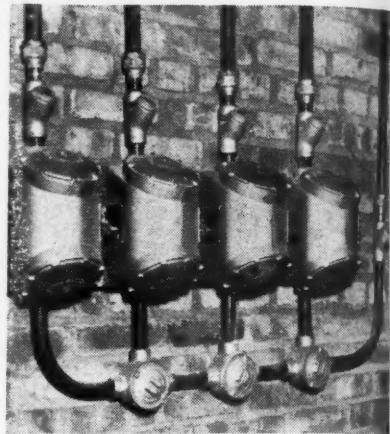
### ADVERTISING

Every organization or individual in business uses envelopes in connection with correspondence. These envelopes are usually printed with the name of the organization, the sender's return address or a slogan. By purchasing envelopes in large quantities, a slightly lower unit price can be obtained and, for this reason as well as for standardization, many firms place bulk orders and buy in quantities sufficient for a considerable length of time.

The Crowder brothers, electrical contractors of Easton and Allentown, Pa., recognize that envelopes offer a valuable medium for carrying messages to customers and the general public. They believe in the old saying that "the busiest bird-dog brings in the most birds" and know that people in general have faith in those companies that are performing outstanding jobs. "Nothing succeeds like success" applies to the electrical field as well as to other branches of industry and the professions.

To keep customers informed of the company's continued progress, Crowder envelopes are ordered in smaller quantities and, every month

or two, the printing is changed to focus attention on a new outstanding electrical installation. Although the expense for printing envelopes is slightly greater, the value of the advertisements more than offsets this small difference. Other contractors in the area may or may not be completing similar installations but the average industrial or commercial engineer, maintenance man or purchasing agent is not acquainted with the fact. Due in part to envelope advertising, these men are Crowder conscious and automatically think of this organization when ordering parts, requesting bids or faced with the necessity for placing an emergency order.



Two lengths of shallow channel iron form wall rack supporting this bank of four 7 1/2-hp., 3-phase, 440-volt explosion-proof starters. Installed by Swenington & Company, Chicago electrical contractor-engineers, the starters serve agitator motors at the Sherwin-Williams Kensington plant. Note sealing fittings on feeder conduit and branch circuits to motors.

## Lever Lugs Hold Fluorescent Fixture

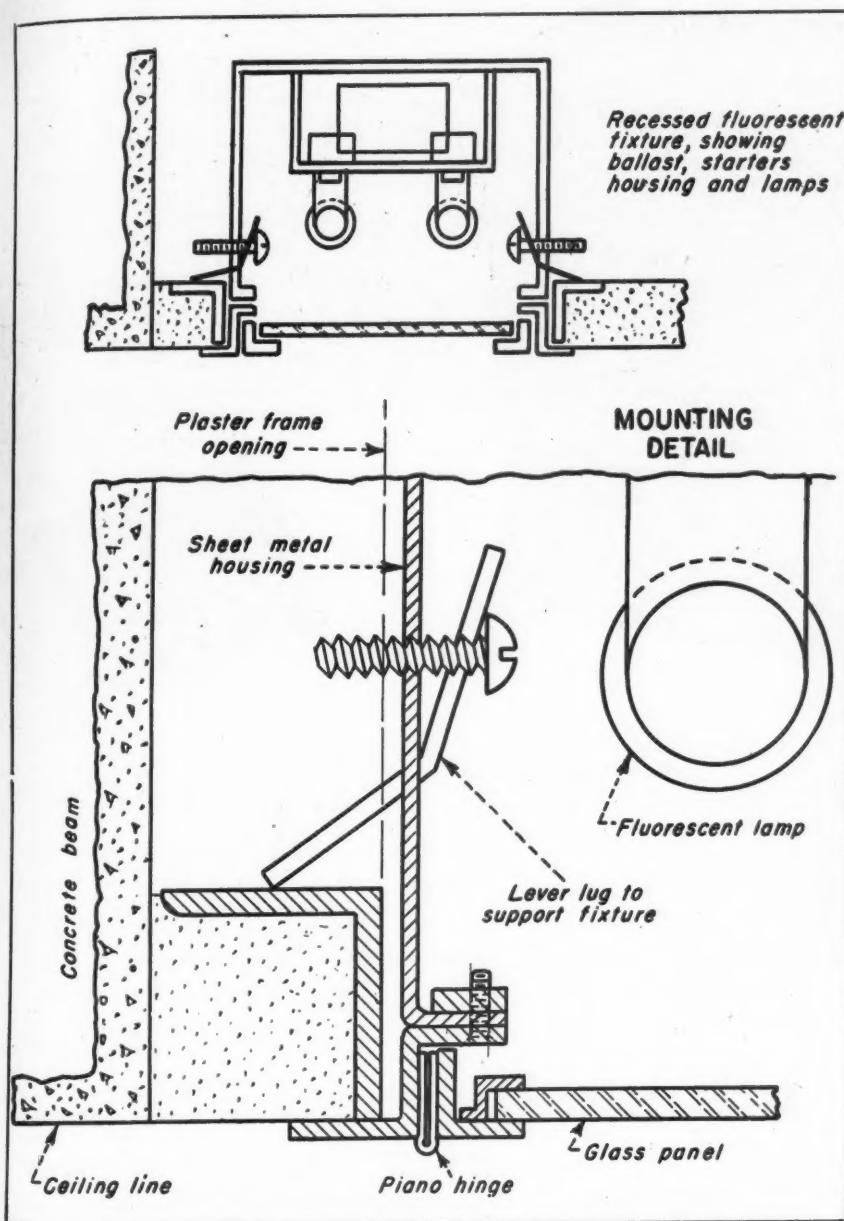
### LIGHTING

The principle of the lever, one of man's first labor-saving devices, is utilized to hold recessed fluorescent fixtures snugly against the ceiling line. A minimum of prefabrication is involved, the adjustment is rapid and simple, and the installed fixture is held firmly in position.

As pictured in the diagram, the



Envelopes of H. N. Crowder Jr. are ordered in small quantities and outstanding electrical installation jobs are used as a frequently-changing confidence-promoting advertisement for the organization. Three recent envelopes, mentioning the wiring of a hospital, dairy and industrial plant, are presented above.



**Lever lugs, through housing of fluorescent recessed fixtures, rest upon framing angles in ceiling and exert downward pressure through action of bolts. Housing is prevented from moving above ceiling line due to Z-angles along opening in housing.**

tion is complete except for wiring.

There are several advantages to the method. Since the bolts do not have to line up with threaded holes after passing through the housing, slight variations do not cause any serious mounting problem. A single framing angle along either side of the housing is sufficient for installation purposes and fabrication is unnecessary. The installation is easy and fast. When mounting large and heavy fixtures, the lever lugs should be of sufficient gauge and stiffness to prevent further bending or weakening through metal fatigue. This method is used by Edward F. Caldwell and Company, New York City lighting designers and engineers.

## Perfect Alignment For Troffers

LIGHTING

Where a large number of lighting fixtures are mounted in rows, even slight deviations in alignment are quickly apparent and detract from the overall impression that the finished installation creates. Aligning fixtures parallel to edges of adjacent structural beams or with the pattern lines of a suspended ceiling give an approximate accuracy but variations of a fraction of an inch may still exist and larger errors are possible when aligning fixtures by eye.

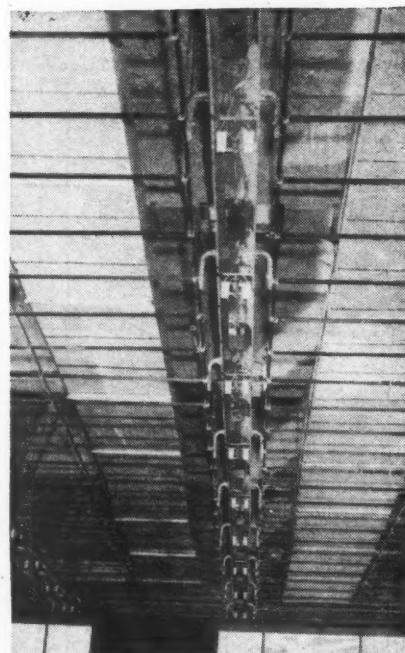
A perfect installation is possible with

the use of a surveying plumb bob and a taut string stretched and fastened along the line of fixture suspension. Elongated slots in the top of fixture mounting yokes permit the electrical worker to adjust the chassis laterally, and slots in the vertical legs of the yokes make it possible to raise or lower the units to the exact desired elevation before fixtures are located permanently by tightening nuts.

While adjustments are being made, the suspension cord of the plumb is



**FIG. 1. Use of plumb bob and taut line assure perfect alignment of fluorescent fixtures in large area ceiling.**



**FIG. 2 Suspended steel framework supports both lighting fixtures and acoustical tile ceiling. Air ducts, separately supported from overhead beams, flank fluorescent troffers.**



## NO DETAILS FORGOTTEN

If you are considering the electrical system for a new plant—or the re-wiring of an existing building—study the advantages of the present practice of simplifying electrical distribution.

The high quality, uniformity of characteristics and long-life performance of Jefferson Electric Power Circuit Transformers have been a factor in the great increase in the use of present-

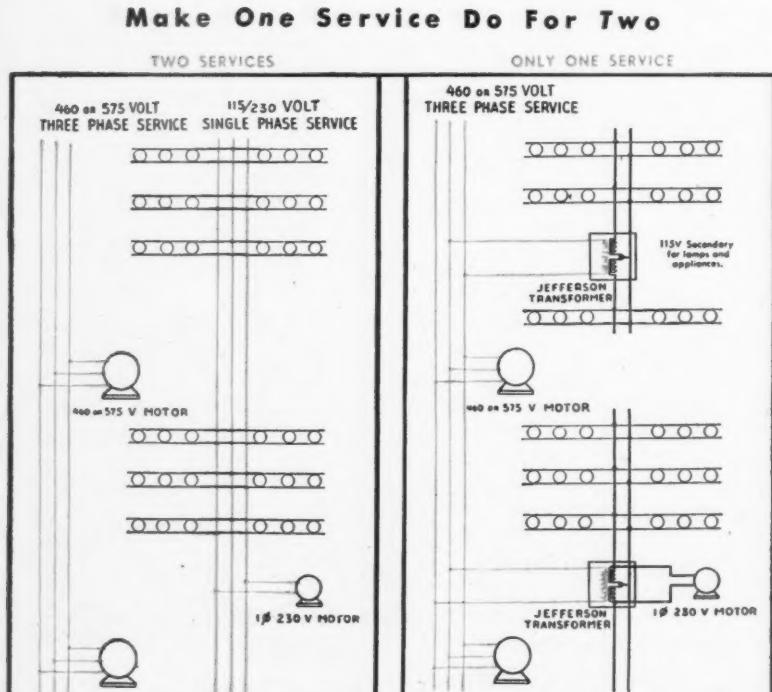
day single service high-voltage plant distribution systems.

These Transformers provide the 115 or 230-volt service wherever desired but only the higher voltage, lower-cost circuit need be installed throughout the plant.

No details are forgotten in the design or construction. Convenient knock-outs, easily accessible roomy wiring compartment, and sturdy mounting brackets save installation time. Air-cooled they require no special vaults or enclosures.

Write for Bul. 461-PCT. JEFFERSON ELECTRIC COMPANY, Bellwood, (Chicago Suburb) Illinois. In Canada: Canadian Jefferson Electric Co., Ltd., 384 Pape Ave., Toronto, Ont.

Listed and Approved by Underwriters' Laboratories, Inc.



This diagram shows two service entrances—one 460 volts and the other 115 volts—requiring two entirely separate wiring systems.

The same requirements are met by the more economical wiring plan through the use of Jefferson Power Circuit Transformers. There is only one service entrance.



POWER CIRCUIT—Dry Type 55°C

# TRANSFORMERS

looped over some protruding nut, bolt or other projecting feature in the fixture assembly, and the fixture is adjusted until the vertical cord of the plumb bob comes in contact with the taut horizontal alignment cord. The bolt or nut from which the plumb is suspended need not be on the exact center line of the fixture assembly so long as these nuts are in exactly the same relative position on both ends of each fixture. Perfect alignment requires each end of each fixture to be separately adjusted.

Fig. 1 shows two men from the organization of Edward J. White, electrical contractor of Newark, N. J., adjusting recessed fluorescent fixtures in the drafting room ceiling of the Air Reduction Sales Company's new research center, New Providence, N. J. The baseboards for the acoustical tiles have already been clipped to the steel ceiling framework and the square tiles will be mounted on this base after the final alignment of lighting fixtures has been completed. Fig. 2 shows another section of the same plant before ceiling tile baseboards have been attached to the framework. Lighting troffers are continuous and will mount two rows of 40 watt lamps end to end. Troffers are located between ductwork for air conditioning system.

## Wall Chart Is Time Saver

SERVICE

Mounted on the office wall of the Electric Apparatus Repair Company, Philadelphia, is a large detailed map of that city. A tape measure is suspended from a central pivot and the chart is framed by series of numbers. To one side is a street directory, followed by groups of coordinated numbers. Maintenance, delivery and service crews use this unusual wall map to quickly locate customer destinations and the direction and distance of these destinations in relation to the office. The use of the chart is a valuable time saver, aiding in locating unfamiliar addresses, reducing unproductive transit periods and speeding emergency and routine service to customers.

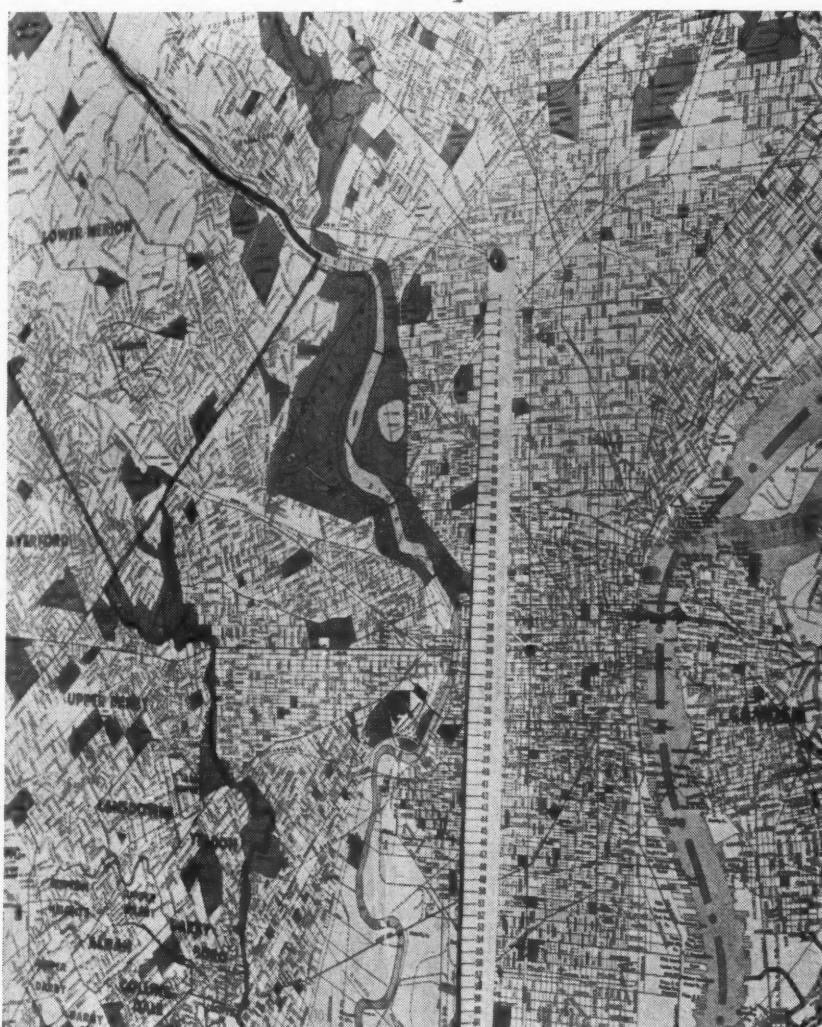
As originally designed, the map employs the tape measure which can be moved freely about the central pivot. The tape is evenly divided by progressively numbered markings, zero being located at the pivot point. Around the four sides of the map other numbers run in unbroken continuity so that,

for example, the left side might be divided by numbers of 1 to 100 running from top to bottom, 101 to 150 from left to right across the bottom, 151 to 250 up the right side and 251 to 300 back across the top to the starting point. To locate a street, indicated on the directory as 281-96, the map user stretches the tape so that it passes over the border mark of 281, then he follows the tape readings from the center out to 96. At the point beneath 96 he will find the destination he seeks.

For more personalized use, this standard map can be altered in order to make the map more valuable to the particular shop or office using it. The pivot point of the tape is located directly over the spot where the shop or office using the map is situated. The tape is numbered as in the former illustration but the markings are drawn to scale so that each division is equal to a quarter of a mile. A directory of customers is prepared in a

manner similar to that used for listing streets, landmarks and public buildings, and is kept in a convenient and readily available place. The customers are positioned on the map with colored pins. Where various types of service are rendered to customers (such as full or partial maintenance, call back service, etc.) or where definite and distinct classes of buildings or industries are served (office buildings, apartment houses, foundries, hospitals, etc.) these differences are indicated by pins of various colors.

In locating customers by this method, the service man instantly spots his destination and knows the direction and distance he must travel to reach the address in question. By referring to the color of the customer pin, he also has a rough idea as to the type of building and the type of tools and parts which he may need for an emergency job. In this manner, time is saved in travel, and return trips are often eliminated.



*Useful wall chart combines a pivoted tape and a continuous series of numbers framing the map. Customer addresses are located through the use of coordinated numbers, stretching the tape to cover the indicated border number and reading along the tape until the exact destination is located. Distance and direction are instantly known.*

# CONFIDENCE.



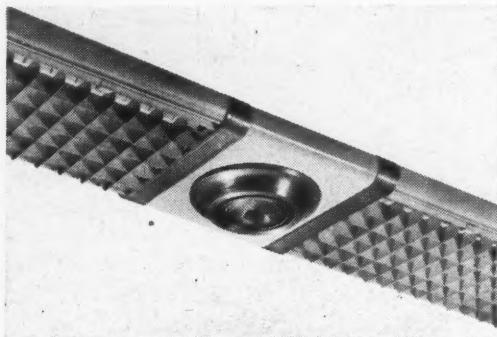
Manufacturers of Wire Rope and Strand • Fittings • Slings • Screen, Hardware and Industrial Wire Cloth • Aerial Wire Rope Systems  
Hard, Annealed or Tempered High and Low Carbon Fine and Specialty Wire, Flat Wire, Cold Rolled Strip and Cold Rolled Spring Steel • Ski Lifts

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of ELECTRICAL CONSTRUCTION and MAINTENANCE you saw the item and they will send full details to you.

# Equipment News

## Adjustable Spot Unit

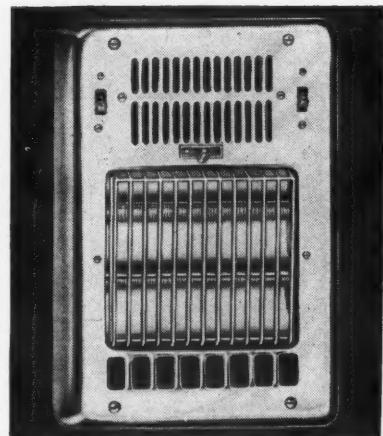
This new adjustable spot unit, designated as "SU-LV-1" is designed for use in conjunction with the "LVR-448" fluorescent luminaire. It takes a PAR 38 lamp, which is mounted in the fixture to permit adjustment to any fixed position up to a 45° angle from the perpendicular, within a 360° circle. Unit housing follows the contour of the "LVR" fixture, and can be mounted individually, between two "LVR" units in continuous row, between two "LVR" units mounted at 90° angle, or at either or both ends of "LVR" unit. Suitable for store interiors, displays or any installation where spotlighting of certain areas is desired. The Spero Electric Corporation, 18222 Lanken Avenue, Cleveland 19, Ohio.



SPERO SPOTLIGHT

## Wall Heater

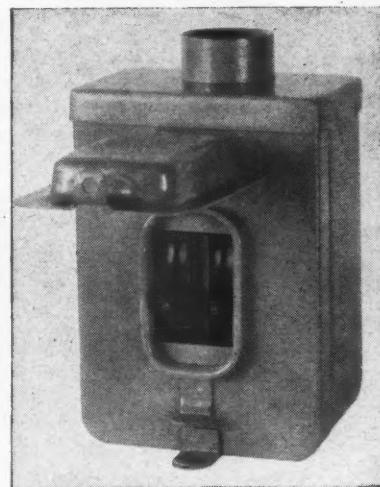
The Fan-Glo Heetaire, Series 230, is a recessed wall heater, that produces infrared rays plus fan-forced heated air. Its construction and principle are the same as in the portable unit. The Neo-Glo elements are glowing bars that produce heat with equal intensity from one end to the other. Units have two switches, so that one element and fan can be shut off at the user's convenience. The front is 12 in. wide by 19 in. high and the box 10½ in. wide by 15 in. high by 3 in. deep. Induction type motor for 50-60 cycle, a-c only. Markel Electric Products, Inc., 145 Seneca Street, Buffalo 3, N. Y.



FAN-GLO HEETAIRE

## Outdoor Service Control Center

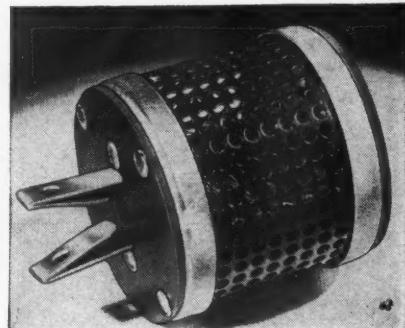
Outdoor service control center, with Quick-lag circuit breakers inside a weatherproof steel enclosure has been announced. Equipped with one or two breakers of either 10, 15, 20, 25, 35 or 50 ampere rating for 2-wire 125 volt a-c or 3-wire 125/250 volt a-c, the wiring circuits are protected against overloads while the cadmium plated enclosure protects the circuit breakers against weather conditions. Standard enclosures are furnished with a 1½ inch hub at the top and two conduit knockouts at the bottom, one for 1 inch the other for 1¼ inch conduit. Centers are adaptable for farmstead wiring where the meter and service control can be mounted on a yard pole or can be mounted with the meter on the outside of a building. Westinghouse Electric Corp., Pittsburgh 30, Pa.



WESTINGHOUSE CONTROL CENTER

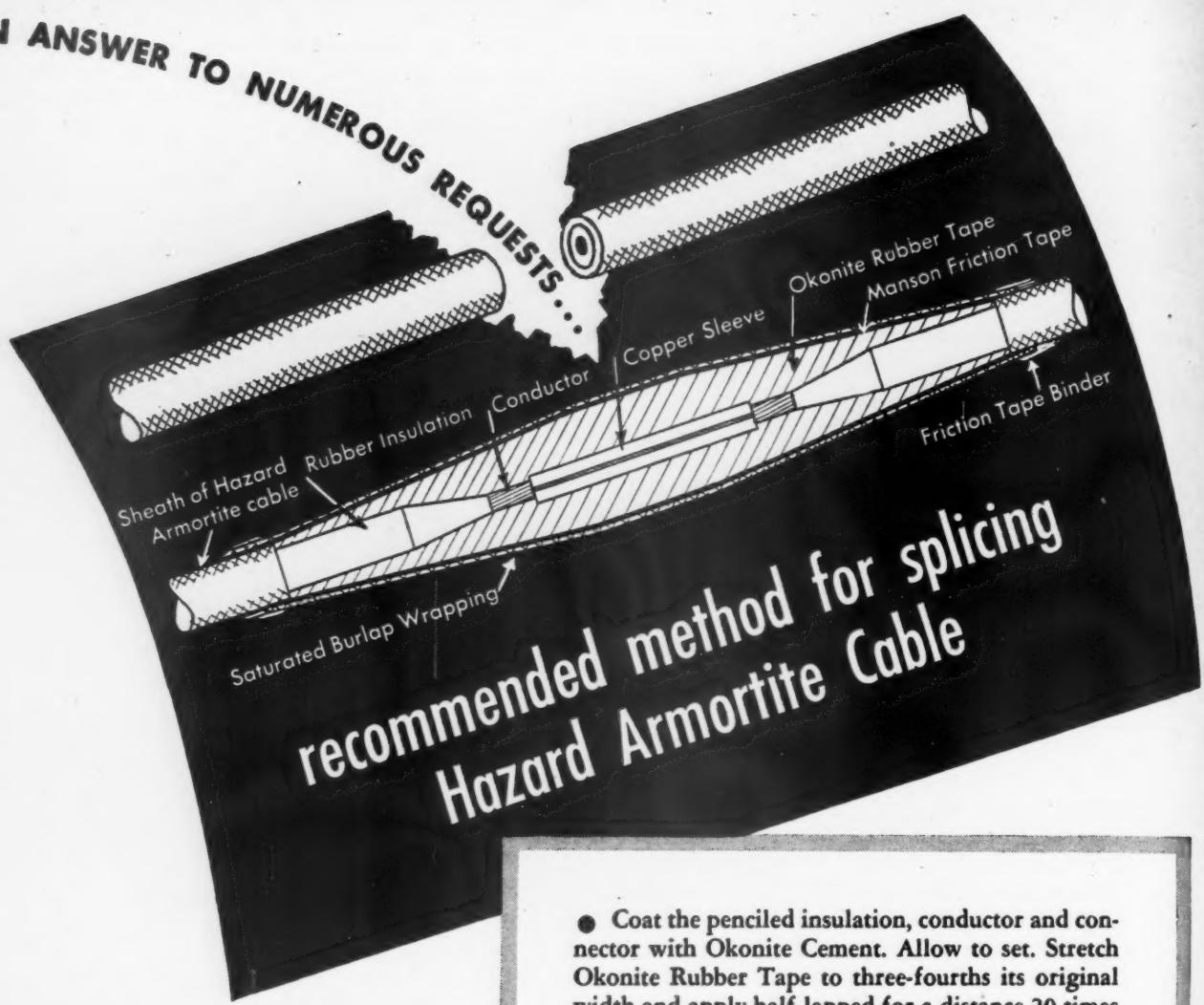
## D-C Conversion Resistor

Inasmuch as fluorescent lamps will not operate on d-c unless a series resistor is included in the power circuit, two handy types of d-c conversion resistors are now available. The accessory type or series AA plugs between usual socket or outlet, and the usual attachment plug. Spring contacts insure positive and permanent connections. The unit measure 1¾ in. diameter by 1¾ inches long. The built-in type or Series GT is a flat perforated case unit with mounting flanges, measuring 7 in. long by 1⅓ in. wide by 1¼ in. high. It is available in a variety of resistance values to function with 15, 20, 30 and 40 watt lamps on 110 and 220 volts. Clarostat Mfg. Co., Inc., 130 Clinton St., Brooklyn 2, N. Y.



CLAROSTAT RESISTOR

IN ANSWER TO NUMEROUS REQUESTS...



→ The increasing use of Hazard Armortite Underground Cable for power and lighting circuits, building entrance installations, and power runs between buildings has brought forth many inquiries as to how this non-metallic sheathed cable should be spliced. You'll find the recommended method described at right simple and foolproof.

Because Armortite requires no lead sheath or steel armor in its construction, reasonably prompt delivery is being made. The Hazard Armortite Bulletin describes in detail the construction, uses and advantages of this outstanding cable which can be buried direct without ducts. Write for a copy today to Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pennsylvania.

- Coat the penciled insulation, conductor and connector with Okonite Cement. Allow to set. Stretch Okonite Rubber Tape to three-fourths its original width and apply half-lapped for a distance 20 times the cable insulation thickness on each side of the connector until the thickness over the connector is  $1\frac{1}{2}$  times the cable insulation thickness. Rolling down successive layers with a warm roller or knife handle will relieve strains and prevent voids.

- Protect the joint with Manson Friction Tape painted with Okolite Weatherproof Paint. Wrap over the painted friction tape two layers of saturated burlap bound at the free ends with a few turns of friction tape.

- Multi-conductor cables are spliced the same way, with Okonite Rubber Tape and Manson Friction Tape on each conductor. Then the conductors are bound together with two layers of Manson Tape, painted with Okolite Weatherproof Paint and covered with two layers of saturated burlap bound down with friction tape.



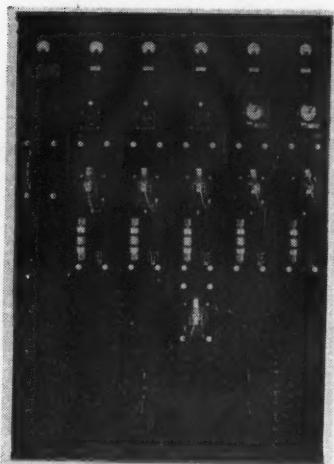
5058

# HAZARD

insulated wires and cables for every electrical use

## Sectionalized Control Panel

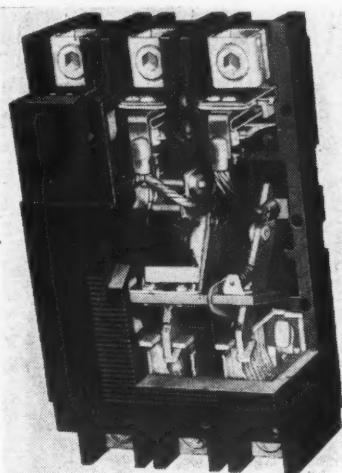
A new type of control panel for battery charges has been developed. Since each section comprises a complete charging circuit, it is only necessary to secure a few frame bolts; extend the main power bus with a jumper; and lengthen the control wires to add more circuits. Features claimed are easy to install; easy to add more circuits; standardized construction, totally enclosed controls, visual control of charging and uniform appearance. The Electric Products Company, 1725 Clarkstone Road, Cleveland 12, Ohio.



ELECTRIC PRODUCTS PANEL

## Circuit Breaker

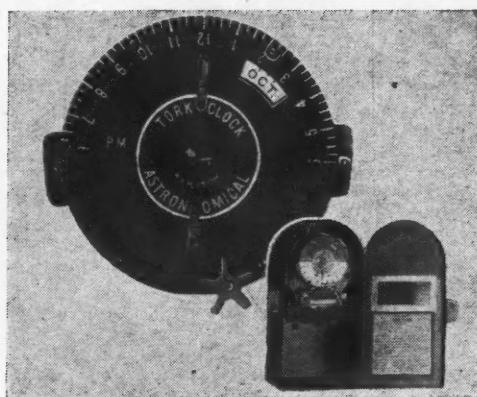
A new compact 225 ampere frame industrial circuit breaker, known as Type ML-3, has been announced. It is 10 $\frac{3}{8}$  in. high by 6 in. wide. Another feature is the use of a new type of solderless connector which facilitates the insertion of heavy cable by swinging open the hinged top of the lug. It is only necessary to cut the cable to proper length, remove sufficient insulation from the end and lay the cable into the lug, snap the hinged top into position and tighten the set screw. Trip ratings are 125 to 225 amperes. Voltages are 125-250 volts d-c 250 volts a-c 600 volts a-c, 250 volts d-c. The breaker is available in dust resisting enclosures with side operated handle for 3 and 4 wire solid neutral applications in addition to 2 and 3 pole devices. It is also furnished in panelboards and switchboards, front or back connected. Square D Company, 6060 Rivard St., Detroit 11, Mich.



SQUARE D CIRCUIT BREAKER

## Lighting Control

This new clock with astronomic dial will turn lights or other electrical equipment "On" at sunset and "off" at sunrise automatically. They may be set to operate exactly at sunset and sunrise or up to 40 minutes before or after. Provision is also made for them to turn "off" at a fixed time, if desired, anywhere between 11 p.m. and 1 a.m. The dial is equipped with a calendar wheel showing the month and day as well as when the switch will operate.



TORK ASTRONOMIC DIAL

Dials operate on standard time. Clocks are self-starting, synchronous-motor driven with beryllium copper blades and special silver alloy contacts. Tork Clock Co., Mt. Vernon, N. Y.

## Duplex Connector

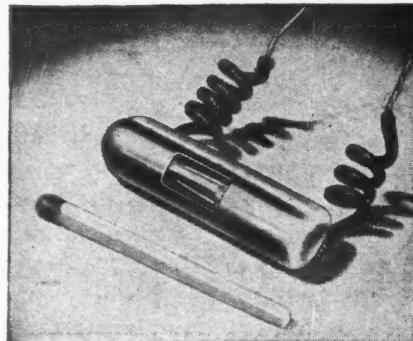
This duplex connector is designed for the new code PVX armored and non-metallic cable. It accommodates two runs of the small cables in a  $\frac{1}{2}$  inch knock-out. A two screw clamp provides an equalized squeeze action that grips both cables under all conditions. The d-c 15 takes the full range of cable sizes from two conductor No. 14 to three conductor No. 10. Gedney Electric Company, RKO Building, Radio City, New York 20, N. Y.



GEDNEY DUPLEX CONNECTOR

## Neon Pilot Light

This pilot light, known as Tiny-Glow, consumes under 1/10th watt and operates at any voltage from 75 to 250, a-c or d-c, with a life of over 10,000 hours of actual burning time. The unit requires two  $13/64$  inch holes in panel or mounting surface to take the mounting studs and nuts. Standard studs are  $3/8$  inch long but other lengths are available on special order. The four inch long insulated tinned leads for the two connections pass through the two mounting studs. Unit is shock and vibration proof. It is especially desirable on instrument panels, electrical and electronic appliances. Industrial Devices, Inc., 22 State Road, Edgewater, N. J.



INDUSTRIAL TINY-GLOW

# Why shut down to move one machine?



DO YOU reach for red ink when machines must be moved? Do you watch production take a dive because a whole line must be shut down to tap in one machine? And do you wince at the cost of rewiring to change a shop set-up?

Then check with BullDog BUStribution DUCT for plug-in power that covers your whole plant.

Every ten-foot section of this modern electrical feeder system has ten convenient outlets. When a machine is moved the electrician need only raise the plug to the nearest outlet, snap its contact fingers over the bus bars and bolt the plug to the casing. He can

do the whole job in twelve minutes or less.

A single machine, or a dozen, can be relocated with no delays for new wiring . . . no interruption of power for the rest of the line.

Built in standardized, prefabricated sections, BullDog BUStribution DUCT can be dismantled, moved and re-installed in new locations or combinations without scrapping a single bolt.

Call your nearby BullDog Field Engineer for full information on this flexible, economical power system, or write BullDog direct for descriptive folders.



## BULLDOG

ELECTRIC PRODUCTS COMPANY

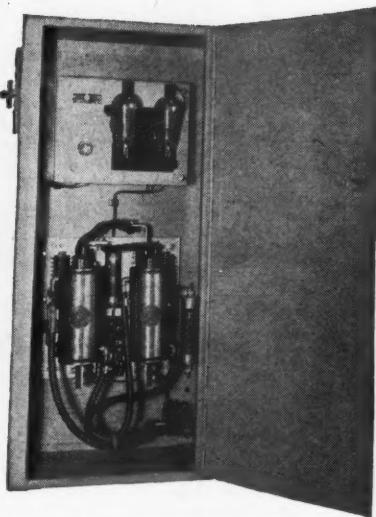


BullDog manufactures Vacu-Break Safety Switches — SafiFuse Panelboards — Superbe and Rocker Type Lighting Panels — Switchboards — Circuit Master Breakers — "Lo-X" Feeder BUStribution DUCT — "Plug-in" Type BUStribution DUCT — Universal Trol-E-Duct for portable lighting — Industrial Trol-E-Duct for portable tools, cranes, hoists.

DETROIT 32, MICHIGAN. FIELD OFFICES IN ALL PRINCIPAL CITIES. IN CANADA: BULLDOG ELECTRIC PRODUCTS OF CANADA, LTD., TORONTO.

## Welding Controls

A new line of non-synchronous electronic resistance welding control combinations has been announced. The new line, designed to meet the new NEMA standards for resistance welding controls, includes combinations of ignitron contactors and sequence-weld timers, with or without electronic heat control, all mounted in one cabinet. Although designed for mounting on the right hand side of the welding machine, the control cabinet can be placed on the floor alongside the machine or mounted on a wall or balcony. By adding extension cable the control station may be mounted at the machine while the main control panel is located remotely. The timing, or front portion of the sequence-weld timer can be removed for servicing. The back panel of the timer, control station, or electronic heat control panel can be removed for replacement. General Electric Company, Schenectady, N. Y.



G-E WELDING CONTROL

control cabinet can be placed on the floor alongside the machine or mounted on a wall or balcony. By adding extension cable the control station may be mounted at the machine while the main control panel is located remotely. The timing, or front portion of the sequence-weld timer can be removed for servicing. The back panel of the timer, control station, or electronic heat control panel can be removed for replacement. General Electric Company, Schenectady, N. Y.

## Alarm System

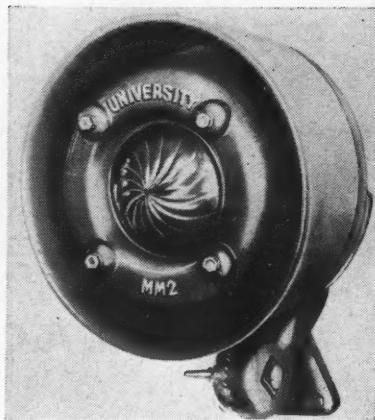
A new fire and cold alarm system, known as Detecto-Master, is for farmhouses, barns, chicken brooders, greenhouses and other buildings on property. It is an automatic electrically operated temperature watchman, which embodies a system of thermostats, spotted in 15 strategic locations about the farm, and a central control unit. When outbreak of fire causes a critical temperature rise at any one of the "Hot" thermostats, the message is transmitted to the control unit which rings a bell; switches on a red light and designates on a meter dial the location of the trouble. The control unit is installed in the owner's or tenant's house, with the thermostats installed throughout the farm buildings. Standard equipment includes 15 master thermostats, one for each of the locating areas on the meter. Up to 300 auxiliary thermostats may be wired into a single area. Some of the thermostats may be used to warn of damaging temperature rises or drops in cold storage areas. A safety feature provides that if a wire or thermostat is accidentally broken somewhere in the system, the alarm bell will ring, the red light flash and the dial-needle register the area of damage. Lord-Taber Company, Inc., Canandaigua, N. Y.



LORD-TABER DETECTO-MASTER

## Loudspeaker

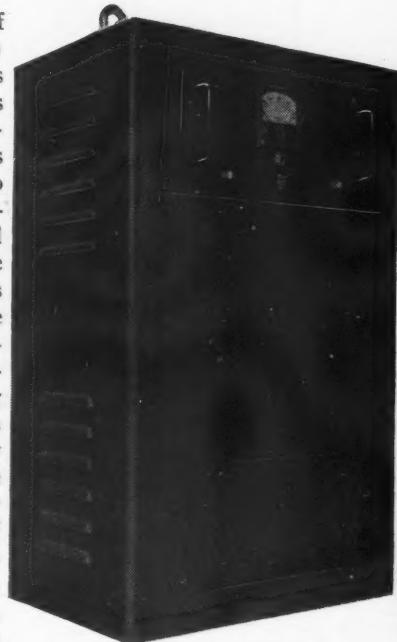
These new loudspeakers have been designed to meet the requirements of marine and railway installations. They feature reflex air columns and built in hermetically sealed driver units. They are available in four types coded MIS, MIL, MM-2 and MM-2F. These speakers are immune to dust, dirt or live steam used for cleaning, and are recommended for docks, open bridges, boiler rooms, locomotive cabs and similar exacting applications. All critical parts are hermetically sealed against dirt, moisture, corrosion or salt spray. On the MM-2 series, a removable deflector permits the diaphragm to be flushed with a hose or wiped to remove incrusted salt or dirt while the speaker is in operation. The MIL and MM-2 mount on an adjustable bracket. Models MIS and MM-2F are designed for flush mounting on bulkheads, panels, etc. University Loudspeakers, Inc., 225 Varick St., New York, N. Y.



UNIVERSITY LOUDSPEAKER

## Automatic Voltage Regulator

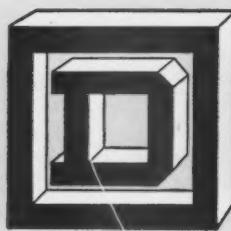
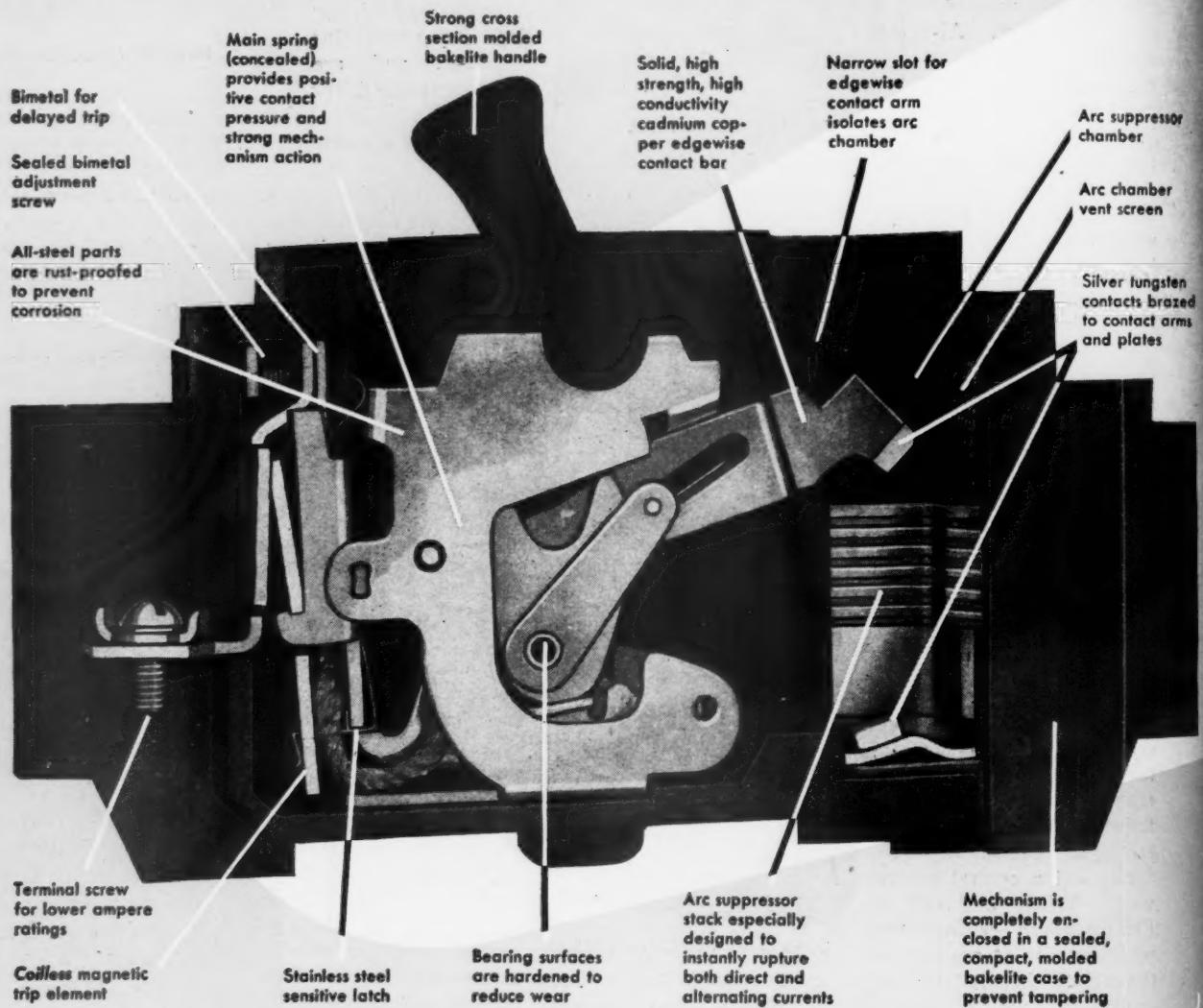
The entire line of Stabiline (Type EM) voltage regulators known in the past as SECO automatic voltage regulators, has been re-engineered to incorporate new electric and mechanical developments. The control circuit dictates the operation of the power elements to provide a constant voltage from fluctuating a-c power lines. It is claimed that the new characteristics of the control circuit offer faster detection of line voltage variations, non-microphonic performance, ease of installation and servicing, elimination of the possibility of damage from shock. All removable components are the plug-in type. All wiring is concealed with no exposed live parts. In rare instances of damage to the control unit, an exchange arrangement permits the complete assembly to be unplugged from the power elements and replaced by another unit. Superior Electric Company, 1020 Church Street, Bristol, Conn.



SUPERIOR REGULATOR

# New **QUICK** *TRIP* **MAKE** **BREAK**

## Type ML A.C./D.C. 1, 2, or 3 Pole, 15 to 50 Amperes



**SQUARE D COMPANY**

DETROIT

MILWAUKEE

LOS ANGELES

*In Canada: SQUARE D CANADA, LTD., TORONTO, ONT. • In Mexico: SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.*

ssor

er

sten  
razed  
arms



# Industrial Electrification

ENGINEERING • INSTALLATION • MAINTENANCE

## Standards for Small Motors

New NEMA program coordinates speed, breakdown torque and service factor with fractional horsepower rating and establishes fixed frame dimensions for motor sizes.

THE establishment and application of the new NEMA standards for fractional horsepower motors will have definite benefits for electrical contractors, application engineers, power suppliers and motor manufacturers. As announced by the Motor and Generator Section of the National Electrical Manufacturers Association, the standards will make possible the accurate selection and application of units, insure greater motor efficiencies, effect long-term savings for customers and reduce production costs. When considering the millions of fractional motors in this quarter-billion-dollar field, incorporated in the installation of heaters, oil burners, stokers, circulating and sump pumps, washing machines, electrical tools, refrigeration units, blowers, coolers, gasoline dispersing pumps and the like, it becomes forcefully apparent that even slight improvements in motor efficiencies will result in tremendous overall savings. Costs of production can definitely be reduced through standardization—the basis for our national economy.

With horsepower ratings included on all motor nameplates, it often is assumed that motors having equal ratings will give like service. Unfortunately for this reasoning, horsepower capacity only partially defines motor performance since operational characteristics also depend on speed, breakdown torque and service factor. Due to these variables, motors produced by different manufacturers can be of the same type and have equal hp. ratings, yet prove unsatisfactory when interchanged or installed with

equipment for which they were not specifically designed. The acceptance of these NEMA standards should insure a motor's load-carrying capacity and should reduce the number of failures caused by misapplication.

### Speed and Torque

In the application of fractional horsepower induction motors, the motor should be selected with a breakdown torque which is sufficient to take care of the maximum peak load requirements of the application. Breakdown torque is the maximum torque which the motor will develop without an abrupt change in speed. In order

that the new standards would be inclusive and serve to provide a definition of rating of any particular motor design, the complete range of breakdown torque was divided into bands for the various standard horsepower ratings. Such a series of torque values associated with corresponding horsepower rating provides a definite classification of any motor in terms of horsepower rating. Table I shows the newly adopted standards for breakdown torque of single phase fractional horsepower motors. Knowing the breakdown torque to be expected from a specified motor will provide a definite guide for determining operational results.

Table I

Small power single phase induction motors shall be rated primarily on the basis of breakdown torque. The value of breakdown torque for the purpose of defining horsepower rating shall fall within the indicated ranges.

Synchronous Approx. Full Load	3600 3450	Revolutions Per Minute					
		3000 2850	1800 1725	1500 1425	1200 1140	900 850	
Brake hp Rating	Breakdown Torque, Oz-Ft						
1/20	2.0-3.7	2.4-4.4	4.0-7.1	4.8-8.5	6.0-10.4	8.0-13.5	
1/12	3.7-6.0	4.4-7.2	7.1-11.5	8.5-13.8	10.4-16.5	13.5-21.5	
1/8	6.0-8.7	7.2-10.5	11.5-16.5	13.8-19.8	16.5-24.1	21.5-31.5	
1/6	8.7-11.5	10.5-13.8	16.5-21.5	19.8-25.8	24.1-31.5	31.5-40.5	
1/4	11.5-16.5	13.8-19.8	21.5-31.5	25.8-37.8	31.5-44.0	40.5-58.0	
1/3	16.5-21.5	19.8-25.8	31.5-40.5	37.8-48.5	44.0-58.0	58.0-77.0	
1/2	21.5-31.5	25.8-37.8	40.5-58.0	48.5-69.5	58.0-82.5	.....	
3/4	31.5-44.0	37.8-53.0	58.0-82.5	69.5-99.0	.....	.....	
1	44.0-58.0	53.0-69.5	.....	.....	.....	.....	

Note 1. Breakdown torque range includes the higher figure, down to, but not including, the lower figure.

### Service Factor

Fractional hp. motors of the open 40 degree C. rise continuous rating, referred to as General Purpose Motors, have a lower temperature rise rating than certain motors designed for specific duty and load conditions which are rated 50 degrees C. rise (open) or 55 degrees C. rise (totally enclosed). These temperature rises are recognized by industry as the maximum compatible with long insulation life.

The users of fractional hp. motors, when applying open 40 degrees C. rise motors on specific applications and known load conditions, have recognized that these motors may be safely operated continuously at loads greater than the hp. rating on the nameplate. It becomes apparent that motor users desire recommendations from the motor manufacturers regarding the safe continuous overloads which would give the maximum safe operating temperatures of the open 40 degrees C. rise motors, considering the inherent 10 degrees C. margin of safety of these motors. This inherent overload ability is referred to as Service Factor. It is a number by which the horsepower rating should be multiplied in order to determine the maximum safe load which may be applied to the motor. For example, if a  $\frac{3}{4}$  hp. motor has a service factor of 1.25, the motor will safely carry .937 horsepower.

Fractional horsepower motors, due to their physical size and value of breakdown torque related to full load torque, as compared with motors of larger rating, have a higher overload

ability than indicated by 1.15 service factor of the larger ratings. It will be noted in Table II that service factors for fractional hp. motors go up as far as 1.4 which means a 40 degree C. motor having a 1.4 service factor may be operated at 140 percent load continuously.

The temperature rise on which the nameplate rating is based shall be no more than 40 degrees C. for all coil windings. This low limiting temperature rise is provided to allow a greater than rated load determined by the service factors listed. It is recommended that service factors be included in nameplate data.

### Locked Rotor Currents

The maximum locked rotor current standard was adopted by NEMA several years ago. The standard provides that the locked-rotor current of 60 cycle, single phase motors (900-3600 rpm, range) of any type, except those split-phase motors at present used on washing machines and ironing machines, shall not exceed the values given in Table III.

Code letters, listed in the standards, designate starting currents in terms of "locked kva. per hp." These code letters are listed in Table IV. Motors of  $\frac{1}{2}$  and  $\frac{3}{4}$  hp. rating have had code letters stamped on their nameplates for several years, and, in the near future, motors smaller than  $\frac{1}{2}$  hp. will also have the code letters on nameplates. It is noted that motors with code letters at the beginning of the alphabet have lower locked currents than those towards the middle or end of the alphabet.

Table II

When authorized by the manufacturers, motors may be operated (at rated voltage and frequency and in an ambient temperature not exceeding 40 degrees C.) at continuous loads greater than rated loads, as indicated by these service factors.

Hp	Service Factor for General Purpose 40 C Induction Motors
1/20.....	1.4
1/12.....	1.4
1/8.....	1.4
1/6.....	1.35
1/4.....	1.35
1/3.....	1.35
1/2.....	1.25
3/4.....	1.25
1 at 3600 rpm only.....	1.25

Table III

Maximum values of locked rotor currents for single phase fractional-horsepower motors, adopted by NEMA, are shown for 115 and 230 volts.

Rated Horsepower	Locked-Rotor Current in Amperes	
	115 Volts	230 Volts
1/6 and smaller.....	20	10
1/4.....	23	11.5
1/3.....	31	15.5
1/2.....	45	22.5
3/4.....	61	30.5

Table IV

Starting currents in terms of "locked kva. per horsepower" are equated to designating code letters in the new standards for small motors.

Code Letter	Kva per Horsepower*	
A	0	3.15
B	3.15	3.55
C	3.55	4.0
D	4.0	4.5
E	4.5	5.0
F	5.0	5.6
G	5.6	6.3
H	6.3	7.1
J	7.1	8.0
K	8.0	9.0
L	9.0	10.0
M	10.0	11.2
N	1.2	12.5
P	12.5	14.0
R	14.0	and up

\*Locked kva per horsepower includes the lower figure, up to but not including the higher figure.

### Standard Dimensions

Wide variations in mounting dimensions and overall physical size of motors produced by different companies has created mechanical problems for manufacturers, users and service men. To permit the use of several makes of motors in a single design of machine, many bases, adapter plates and other mounting facilities have been necessary. Some manufacturers have had to supply special bases and end plates to adapt their unit to equipment designed for the motor of another manufacturer. Increased tooling costs and production time have resulted. Replacing a motor with one of another make often creates similar problems.

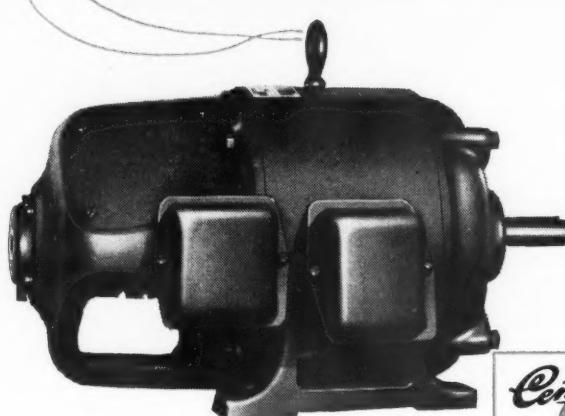
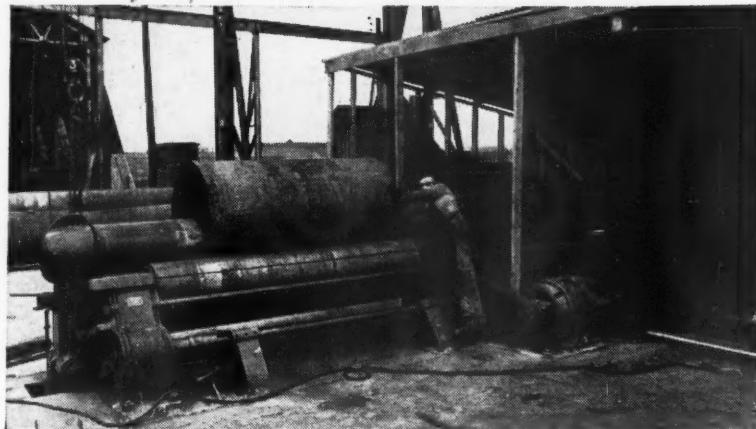
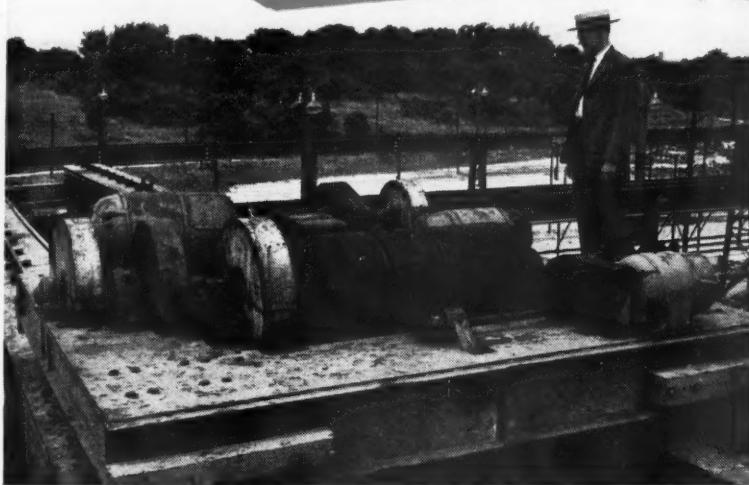
Manufacturers now use separate

systems for frame designation—some employing numbers, others letters, and still others using a combination of both to properly designate frame sizes. These designations are more confusing than helpful when comparing units of different makes.

The new dimension standard is modeled after the integral-horsepower system which employs frame sizes 203 through 505. In numbering frames, the number will be 16 times the shaft height (D dimension). Illustrated in the drawing are three new standard frames; 42, 56 and 66. The BA, E, F and H dimensions will be constant for any given D dimension or frame size. Suffix letters will be used to indicate the same features now indicated in the integral system, and,

# CENTURY Slip Ring Motors

Provide Maximum Flexibility — For  
Speed Regulation . . . Torque Control . . .  
Reversing Direction of Rotation



The two installations shown here demonstrate how Century Slip Ring Motors provide the flexibility needed to meet varying load conditions.

Illustration No. 1 shows 4 Century Totally Enclosed Slip Ring Motors on an outdoor crane. One motor powers the crane travel, one the carriage cross travel, one on small load hook and one on large load hook.

Century Slip Ring Motors provide variable speeds for the travel and hoist motions of the crane. Reversing direction of rotation permits crane travel in either direction.

In Illustration No. 2 the bending roll is driven by 2 Century Slip Ring Motors—75 horsepower and 30 horsepower. One operates the two power rolls and the other raises and lowers the third roll which regulates the amount of curvature of the steel plate.

Because plate thickness up to  $1\frac{1}{8}$ " are handled, this machine requires a great variety of speeds and torque. Low starting current is another requirement which is easily met by Century Slip Ring Motors.

When your requirements demand that electric motors have flexibility for speed variation, torque control, reversing of direction of rotation and high starting torque with low starting current, specify Century Slip Ring Motors.

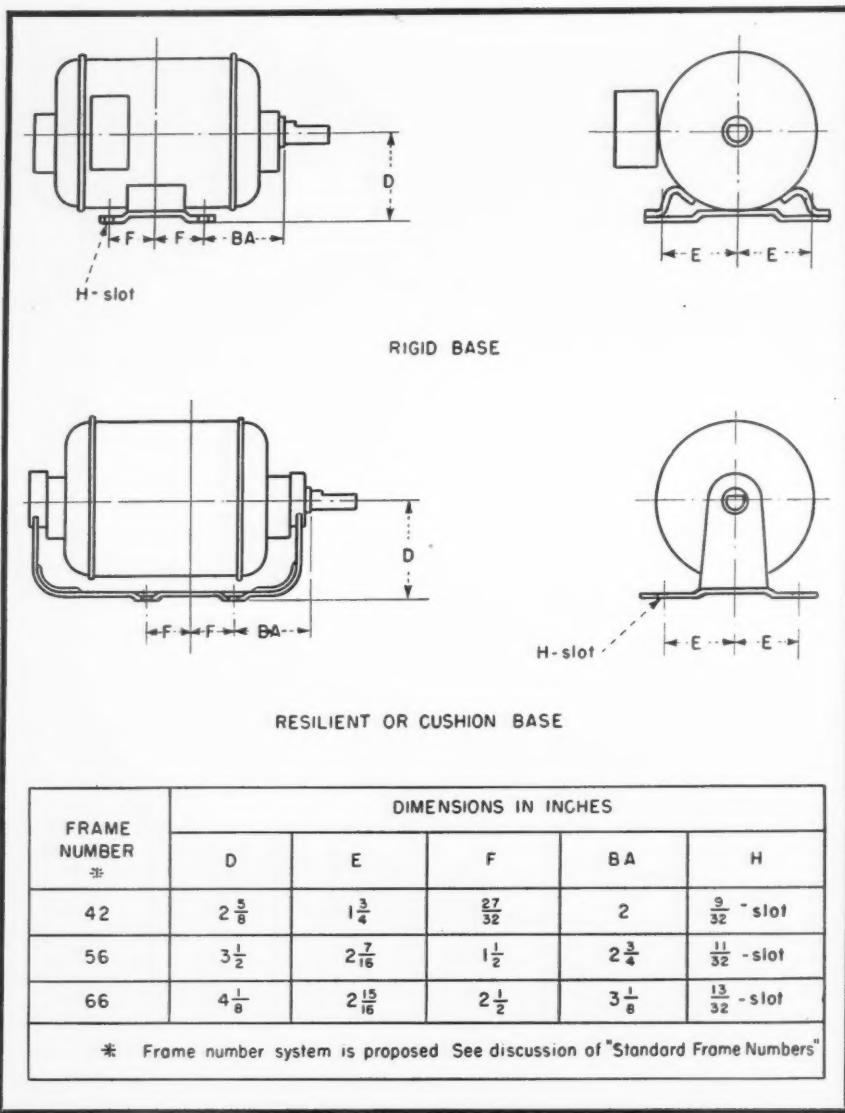
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Specify Century for all your electric power needs.

**CENTURY ELECTRIC COMPANY**

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FRAME NUMBER *	DIMENSIONS IN INCHES				
	D	E	F	BA	H
42	2 $\frac{5}{8}$	1 $\frac{3}{4}$	$\frac{27}{32}$	2	$\frac{9}{32}$ - slot
56	3 $\frac{1}{2}$	2 $\frac{7}{16}$	1 $\frac{1}{2}$	$2\frac{3}{4}$	$\frac{11}{32}$ - slot
66	4 $\frac{1}{8}$	2 $\frac{15}{16}$	$2\frac{1}{2}$	$3\frac{1}{8}$	$\frac{13}{32}$ - slot

\* Frame number system is proposed. See discussion of "Standard Frame Numbers".

*The three standardized frames for motors 1/20 through 3/4 hp. will eliminate difficulties associated with initial application as well as with replacements.*

therefore, the same frame numbers with proper suffix letters (when assigned) would be used for vertical and flange motors as are designated for the horizontal motors of corresponding sizes. Individual manufacturers may use any letter preceding the frame number, but such a letter would have no reference to standardized dimensions. For example, a number 66 frame might be designated as 66 by one manufacturer and as A66 by another, yet the D, BA, E, F and H dimensions of both frames would be identical and would be the values shown above.

Dimension standards apply to both rigid and resilient or cushion base motors. These dimensions apply to motors from 1/20 through  $\frac{3}{4}$  hp., 1800 rpm. (1 hp., 3600 rpm.). The H dimension of 13/32-inch slot and BA

dimension of 3 $\frac{1}{8}$  inches in the largest frame has been established for the purpose of matching the integral horsepower 203 frame (1 hp., 1800 rpm.) which has an H dimension of 13/32-inch hole and BA dimension of 3 $\frac{1}{8}$  inches. This will provide for interchangeability on belt drive machines, using both fractional and integral horsepower motors. At the present time, no horsepower and speed ratings will be assigned to these frame sizes.

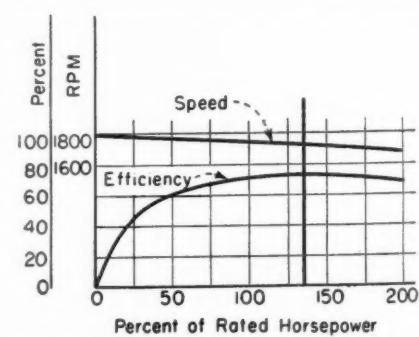
#### Conclusion

The new standards, coordinating the above-mentioned variables, will aid materially in guaranteed motor performance. Compliance with the standards will be voluntary, but it is expected that the advantages to be gained will motivate wide acceptance. Elec-

trical contractors, engineers and designers should find that standardization of motor ratings will result in greater accuracy in recommending applications, size of wiring, controls and protective equipment.

Just as observation of performance resulted in the establishment of methods, and a summary of methods led to accepted practices, so it follows that coordination of practices must be obtained through standardization.

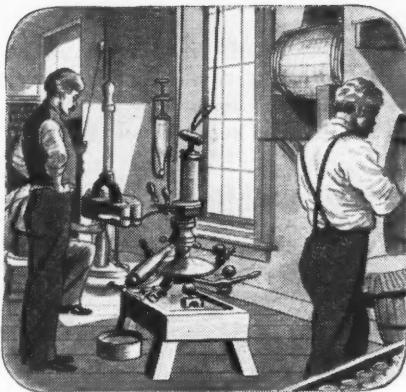
The establishment of standards in any industry is of vital value to both manufacturer and ultimate user or consumer. It is said that industrial standardization is a consolidation of position after an engineering advance has been made. Associations working for these benefits include the American Standards Association, Edison Electric Institute, American Society for Testing Materials, National Fire Protection Association, NEMA and many other equally-familiar groups. As defined in the NEMA by-laws, the purpose of standards is "in the public interest and are designed to eliminate misunderstandings between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining without delay the proper product for its particular need. Existence of a standard does not in any respect preclude the manufacturing or selling of products not conforming to the standard". The standards do not attempt to cover detailed features of design or detailed methods of manufacture. While standardizing on capacities, ratings and dimensions, there is no standardization of ideas. Individual initiative remains unrestricted and changes are to be expected in the interest of progress.



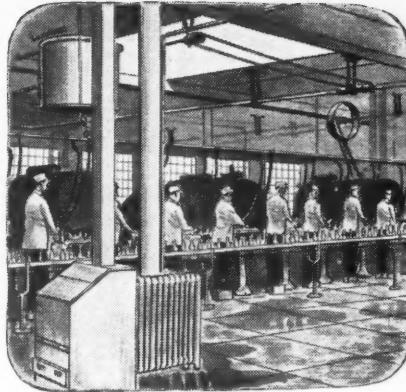
*Speed and efficiency plotted against percentage of rated horsepower of a typical 1/3 hp., single phase, 60 cycle, 1725 rpm. motor. Maximum efficiency is shown to be at 135 percent. As indicated in Table II, 1.35 is the service factor for a unit of this size.*



1 1785—Townsend Speakman, druggist, at the suggestion of one Dr. Physick, produced an artificially carbonated water for its health value. Soon, fruit juices were added for flavor and the soft drink business was under way in America.



2 1880—Bottling machines looked like this. Work was mostly by hand in crude workshops. People went for the new "pop", not only as a beverage, but as a "cure" for gout and many other ailments. New methods were still to come.



3 1915—Howell engineers began working with machinery manufacturers to apply industrial type motors, specially designed, for the particular applications in bottling. Soon Howell "Red Band" Motors appeared in this and many other industries.

## Then, "Pop" became a billion dollar business!

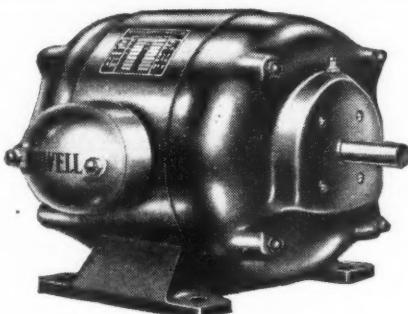


4 Today—Soft drinks are as much a vital part of America as the "hot dog" and the "hamburger." More than a billion dollars' worth, each year, is mass-produced under rigid sanitary standards in spotless factories operated by electrical horsepower.

In the Soft Drink Industry you'll find Howell industrial type motors operating bottlers, conveyors, carbonators, cappers and agitators. In many other great American industries, too, you'll find Howell motors powering the machines of production, as well as air conditioning and ventilating equipment. And, best of all, if you ask Howell users, you'll find that Howells are making good on their hard jobs.

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Be wise—buy industrial type Howell Motors! They're designed for the toughest operating conditions in industry; consequently, they perform better on all jobs!

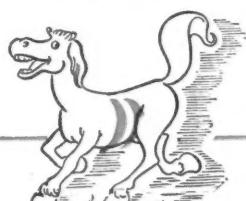


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# Reader's Quiz

## Photo Electric Door Opener

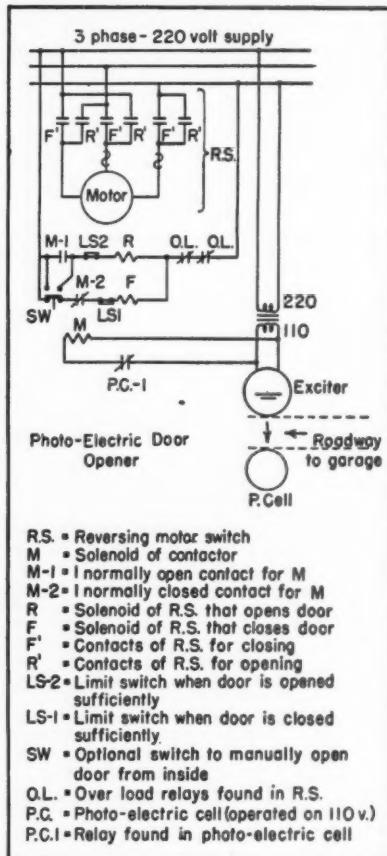
**Q**UESTION 246—We are installing a photo electric cell controlled door in our building that will slide open and shut on a track. Can someone give us a system that can be used to give the following action?

As the customer enters and breaks the beam, the door starts to open. The customer starts back, restoring the beam and the door stops at this point and starts closing. The customer then comes back, breaks the beam again, causing the door to start opening again without having ever gone completely shut. In other words, the door could be made to go forward or backward by breaking and making the beam, and would move back and forth without going wide open or clear shut.—J.F.

**A.** TO QUESTION 246—In the normal condition when no car is involved—the beam is not interrupted and the photo cell relay is closed or energized, thus energizing the solenoid "M" of the contactor. This contactor has two contacts, one normally closed and the other normally open. In this condition the N. C. contactor (M-2) energizes solenoid "F" of the R. S. and the door closes—door travels until limit switch "LS-1" opens circuit.

Now let us assume a car enters roadway and breaks the beam. This opens the Cell Relay, PC. 1 which de-energizes "M" which is the solenoid of the contactor. By doing this its contactor "M-2" opens and contactor "M-1" which was opened now closes. This energizes solenoid "R" of the R. S. and the door opens and continues to open until it reaches the end of its travel and the limit switch opens the circuit.

As you require—this circuit allows for the door partially opening and closing depending on the position of the car.



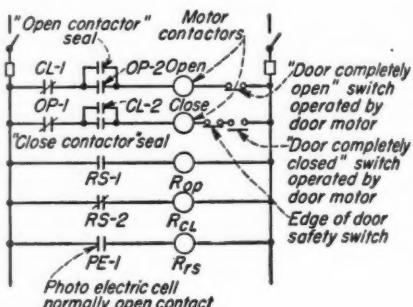
The switch "SW" is purely optional but it will allow one to open the door from inside—or such an arrangement could be had to close the door from the inside. This switch happens to be a "control" type switch with a mechanical jog attachment. In its normal position the circuit is closed.—E.A.M.

**A.** TO QUESTION 246—The simplest solution to J. F.'s photo electric cell controlled door problem is the use of a ratchet type sequence relay used in a control scheme similar to the sketch.

The ratchet type sequence relay  $R_{RS}$  is a two pole relay with one NO and one NC contact. Each time the relay is momentarily energized through contact P.E.-1 closing when the light beam is broken the closed contacts open and the open contacts close. They remain in these positions until the next time contact P.E.-1

closes which of course is the next time the light beam is broken. Then the relay is restored to its original position.

Contacts on relay  $R_{RS}$  operate auxiliary relays  $R_{OP}$  and  $R_{CL}$ . The auxiliary contacts operate in such a way that they break one circuit and close another. Thus the sequence is such that when the light beam to the photo electric cell is broken, the door starts to open. When the beam is broken again the door stops and starts to close. If the beam is broken a third time, the door stops and starts to



open. Unless the light beam is again broken, the door continues to open until the door is completely open at which time the "Door Completely Open" switch geared to the door motor opens and de-energizes the "open" circuit.—M.D.P.

**A.** TO QUESTION 246—In the first diagram, I am using a General Electric #CR7505 - K100 photoelectric relay. This relay operates in such a way that while the light beam is interrupted, a D.P.D.T. relay is energized. This action makes a set of two normally open contacts and breaks a set of two normally closed contacts simultaneously. When the light beam is not broken, the reverse is true. The relay is at rest and the n.o. contacts are open and the n.c. contacts are closed. In the diagram I have used the n.o. contacts for the "OPEN" circuit and the n.c. contacts for the "CLOSE" circuit. In this way when the beam is broken, the "OPEN" circuit is completed while the "CLOSE" circuit is

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## FUSETRONS provide simplest way to prevent damage from single phasing

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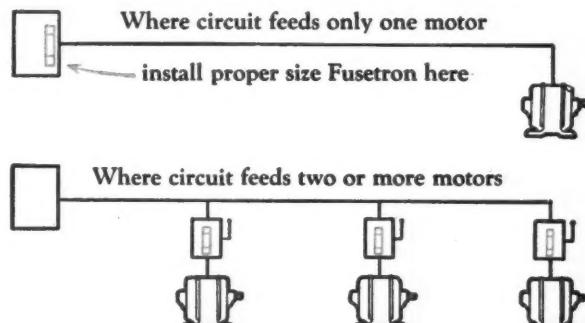
This 100% overload on Fusetrons of MOTOR-RUNNING protection size opens them and STOPS FLOW OF CURRENT to the motor.

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## FUSETRONS make protection of SMALL Motors against burnout, simple and inexpensive

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- ★ Prevent needless blows caused by heating in panels and switches. ★ Permit use of larger motor or adding more motors on circuit without installing larger switch or panel. ★ On new installations proper size switches and panels can be used instead of oversize. ★ Protect coils, transformers and solenoids against burnout.
- ★ Protect motors against burnout (see above)

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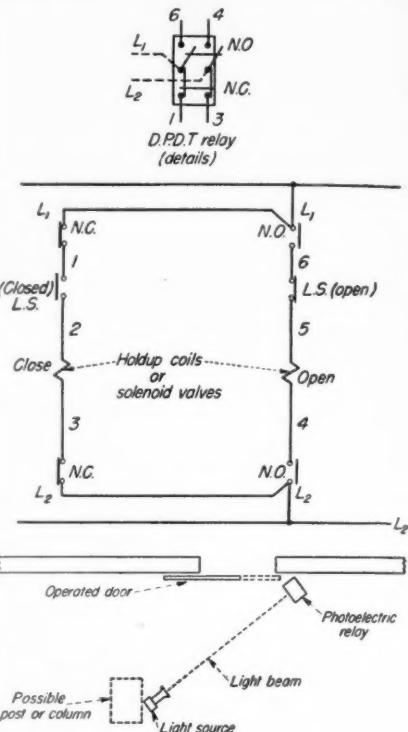
Lock fuses and clips together. Eliminate burnt fuses and clips—lost production—unnecessary shutdowns and wasted current. There's a size for every clip. Write for Bulletin No. 6



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broken. The two limit switches (labeled LS) are placed in the circuits to prevent jamming of the door-opening mechanism when the door reaches fully open or fully closed position.

The diagram shows the photo electric relay (D.P.D.T.) placed in the control circuit of the door opening equipment. If electric motors are



used for this action, the relay may control the two holdup coils of a reversing magnetic switch. Also, if compressed air or hydraulic methods are involved, the relay may operate the two solenoid valves controlling the flow of either air or fluid used in operating the door.

As the light beam is interrupted, the relay closes the "OPEN" coil circuit thus starting the "OPEN" motor or opening the "OPEN" valve. This continues as long as the beam is broken. However, if the light beam is restored, the relay opens the "OPEN" circuit and immediately closes the "CLOSE" circuit. This instantly starts the door on its way shut. If the door reaches a fully open or fully shut position the limit switches break the circuit then in use, thus preventing a jamming of the door. As the light beam is broken and restored repeatedly, the door will respond accordingly, opening and closing without coming to fully open or closed position. However, if the beam is left broken for a sufficient length of time, the door will open fully and the limit switch will break the circuit. Naturally, the reverse is true if the beam is left unbroken for a long period of time, the door will close completely and the "SHUT"



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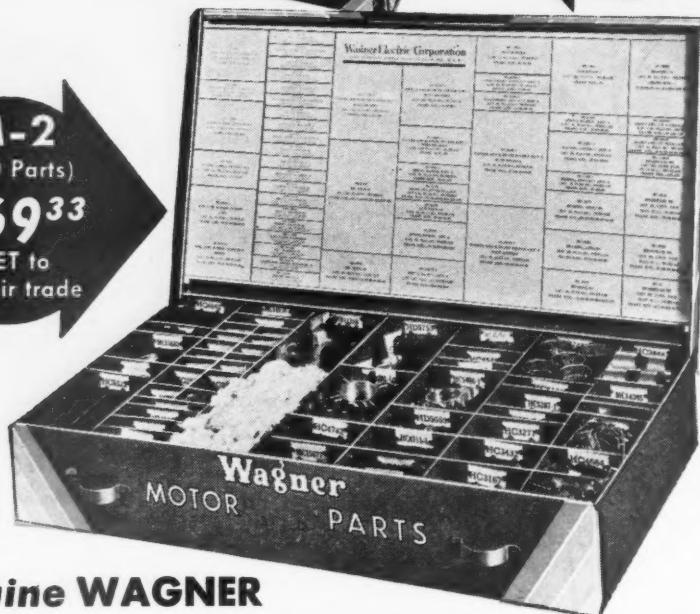
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F. O. B. (Quantity) Shipping Weight 3 pounds

Point of Shipment ..... Motor Parts Assortment M-2 (\$169.33 net each) .....  
(Quantity) Shipping Weight 46 pounds

Total \$.....

Order No. ....

Company.....

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**Wagner**



**Electric**

limit switch will open the circuit. The length of time required depends upon the size of the door and the speed with which it operates. However, there is one thing that troubles me (and probably will J.F.). Unless the light beam is located close to the door or unless the "customer" is very nimble there is the possibility of the person getting caught between the door and the casing. This is true since the door starts to close as soon as the light source is unobstructed, i.e., as soon as the person passes through the beam. Possibly this could be partially rectified by arranging the equipment in such a way that the beam would remain broken for a longer time. In the second sketch I have suggested one method that will help the situation. By setting the light beam *on an angle* the light beam will be broken for a longer time than usual. This will increase the operating cycle of opening the door and will allow the door to open wider without delay to the person passing through.—W.R.S.

## Power Factor Correction

**Q**UESTION 247—*A 100 kva. capacitor bank, installed for power factor correction on a 3 phase, 60 cycle, 480 volt system, heats excessively. How can we determine if this is caused by harmonics and if so, what is the remedy?*—J.J.L.

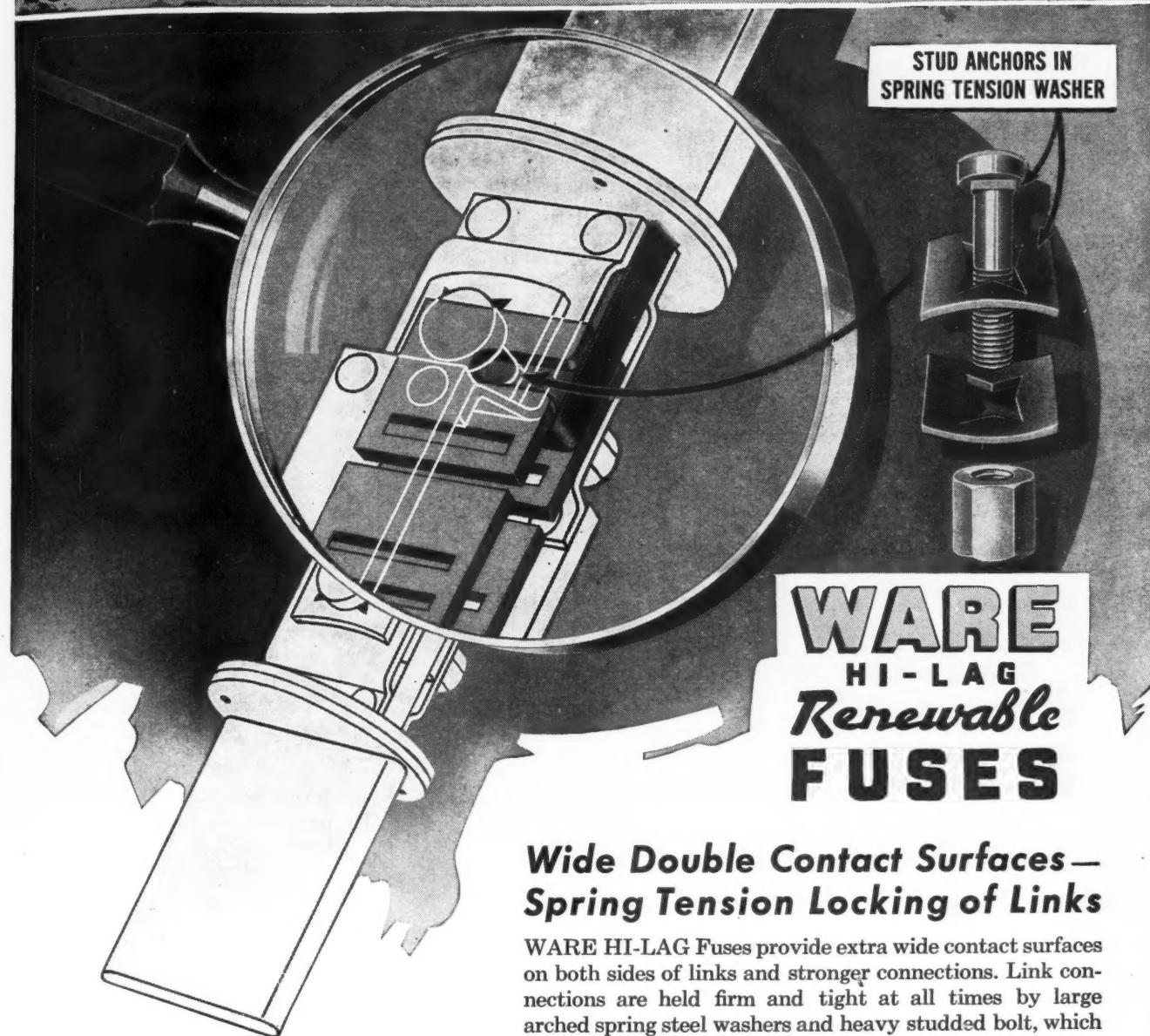
**A.** TO QUESTION 247—*Determination:* Produce a voltage drop of 0.05 volts or more in the lead to the capacitor bank, and put this voltage on a cathode ray oscilloscope. The voltage drop may be obtained on an ammeter, or simpler still, on a piece of wire of sufficient length and cross-section. An oscilloscope may be available at your radio repair man next door.

*Remedy:* A large charging current of, say, the 5th harmonic occurs when the capacity of the bank resonates at  $5 \times 60 = 300$  cycles with the inductance of the associated transformers, motors, etc. To detune the circuit, increase or decrease the number of capacitor units (that is, vary the capacity of the bank), or change transformer taps, replace oversize motors by smaller ones, or the like (that is, change the inductance). Success is indicated by disappearance of the harmonics on the oscilloscope screen so that only the fundamental sine wave (60 cycles) remains.—L.F.R.

**A.** TO QUESTION 247—*Standard enclosed housed or*

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## LOOK TO WARE HI-LAG FUSE FOR PRODUCTION PROGRESS



### WARE HI-LAG *Renewable* FUSES

#### Wide Double Contact Surfaces— Spring Tension Locking of Links

WARE HI-LAG Fuses provide extra wide contact surfaces on both sides of links and stronger connections. Link connections are held firm and tight at all times by large arched spring steel washers and heavy studded bolt, which locks the links into the circuit.

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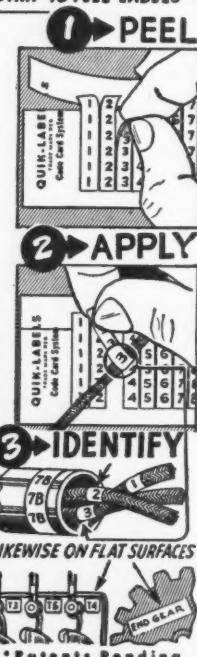
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BRUSHES

ELECTRICAL CONSTRUCTION AND MAINTENANCE JUNE 1947

stacked capacitors are designed to operate at 104 degrees F., hanger type units at 122 degrees F., and pole type at 115 degrees F. They will carry a maximum of 135% of their rated kva. continuously without overheating. Check the voltage and current with a copper oxide recording voltmeter and ammeter. Multiply the results to get approximate kva. of the 60 cycles current plus the harmonics. If the kva. is too high, you will have to insert a bucking transformer or a capacitor in series with the large capacitor to reduce the kva. load on the capacitors. If the surrounding temperature is too high, you can blow air on the capacitors, use a capacitor designed for the purpose, or reduce the kva. load. I use a copper oxide meter because it is effected by distorted wave form about the same as a capacitor.—H.S.

**A.** TO QUESTION 247—The improper selection of a capacitor bank for power factor correction in a three-phase system may result in a condition of resonance between the capacitors and the supply line or the equipment connected to it. This resonance may increase the harmonic currents in the system and cause the capacitors to overheat.

Suitable reactors, or reactors shunted with resistors, connected in series with each set of capacitors may be used to overcome this resonant condition. Where possible, changing the size of capacitors or their location may be the easiest way to determine whether the overheating is due to pronounced harmonic currents resulting from an unfortunate combination of circuit constants.—R.G.C.

## Frequency Regulation

**QUESTION 248—**What is the best method of obtaining about 5 kw. of 50 cycle, 120 volt power? A 60 cycle source is available to supply the frequency changing equipment. If possible, the 50 cycle should be as close in frequency regulation as the 60 cycle power source.—C.P.S.

**A.** TO QUESTION 248 — For close frequency regulation, a 60 cycle synchronous motor must drive a 50 cycle synchronous generator. The highest speed that could be used on direct connected machines is 600 rpm. This comes from the relation:

$$\text{Frequency} = \text{Number of poles} \times 100 + 120 \quad (1)$$

Some latitude in choosing equipment will be afforded by the substitution

of a belt drive or a gear drive. Having settled on the speed of the machines, the constants of the drive may be determined by the relation:

$$\text{Pulley diameter (drive)} \times \text{rpm. (drive)} = \text{Pulley diameter (driven)} \times \text{rpm. (driven)} \quad (2)$$

If a geared connection is used, number of teeth on driver and driven gears is used in place of the pulley diameters in Equation 2.

If a small voltage and frequency variation (about 5%) can be tolerated on the 50 cycle system, an induction motor may be used as the driving unit. Equations 1 and 2 would still hold. The variation is due to the speed-torque characteristics of an induction motor.

Going still further in attempting to find workable substitutes for the ideal, a 60 cycle generator could be used on the 50 cycle end of the motor-generator set. Excitation would have to be increased about 20% to offset the reduction in speed.

The driving motor must be large enough to supply the desired output of the generator, plus the losses in both machines. A 7½ hp. or a 10 hp. motor would do the job in this case. Efficiency considerations are of no moment in such a small combination.

Parenthetically, it may be pointed out that a 50 cycle transformer or a 50 cycle induction motor will work at rated voltage on a 60 cycle system, with little observable changes in operating characteristics.—L.E.B.

**A.** TO QUESTION 248 — I should like to point out that the company with which I am associated has had the same problem. We manufacture transformers for the Canadian and the export market. The frequencies with which we are primarily concerned are 25 cps. for the Ontario market, 50 cps. for the export market, 60 cps. for the rest of the Canadian market, 120 cps. for testing transformers at double frequency, 400 cps. for aircraft units, 800 cps. and 2400 cps. for other special types, 1000 cps. for audio tests. In order to cover this wide range we found it inadvisable to purchase a motor generator set owing to the various sizes required, maintenance problems, etc.

We finally decided upon an electronic unit. A simple unit was constructed consisting of an audio oscillator with pushbutton frequency tuning control and a high power audio amplifier. By the use of a phase shift circuit in the oscillator, a high order of frequency stability was obtained. The voltage output was readily adjustable by a volume control on the input to the power amplifier.

An electronic unit of this nature has

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### INDUSTRIAL CONSTRUCTION

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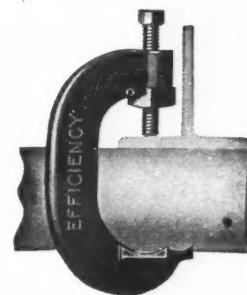


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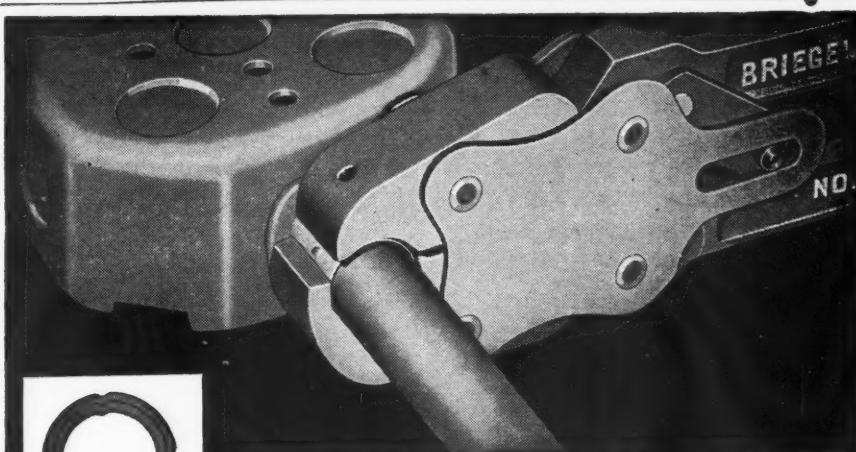
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For ½" and ¾" conduit  
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the advantage that any frequency within the range of the power amplifier may be obtained. Where desired, an electronic circuit may be added that would tie the incoming frequency, in this case 60 cps., to the outgoing frequency. Overall voltage stability, i.e., good regulation, may be incorporated into the unit through the use of a negative feedback circuit.—H.H.S.

**A.** TO QUESTION 248 — To obtain 50 cycles from a 60 cycle motor, you must use some sort of frequency changing equipment. There are several ways of doing this; the following order being the more popular, preferable ways:

- (1) Use a rotary converter. This will give you a 50 cycle source regulated directly from 60 cycle line.
- (2) Use a 60 cycle synchronous motor direct connected to a 50 cycle generator. This would require, say, a 12 pole motor operating at 600 rpm. and driving a 10 pole generator supplying 50 cycles at 600 rpm. This again would be a directly controlled frequency.
- (3) A belted motor-generator set, but belt slippage would not permit exact frequency control on output.
- (4) An electronic converter, using probable ignition takes and a firing circuit controlled from the 60 cycle source. This could be made a directly controlled frequency output, but wave form would be bad.

Other methods of conversion are available, but method (1) or method (2) would probably be the most satisfactory of those methods generally available for an output of 5 kw.—L.R.B.

## Coil Winding

**Q**UESTION 249—In regard to 3 phase stator winding coils, can someone tell me what the difference is between a right hand coil and a left hand coil? If a winding has left hand coils, what effect would there be on a stator's operation if right hand coils were used and vice versa.—E.J.K.

**A.** TO QUESTION 249 — The difference between a right and left hand coil merely reverses the coil sides from top to bottom of slot and bottom to top. In the right hand coil the winding progression is clockwise facing the connection end and the left hand is counter clockwise. If properly connected, this will not change the motor operation.—R.D.R.

**A.** TO QUESTION 249 — The only difference between left hand and right hand coils is the way

they are placed in the stator. Left hand coils are placed in the stator with the leads on the operator's left.

Right hand coils are placed in the stator with the leads to the operator's right.

When buying slot coils from a factory, the jumper between coils in a group will usually determine if they are to be placed in the stator right handed or left handed.

To change from a left to a right handed coil or vice versa does not alter the operating characteristics of a three phase motor.—L.A.H.

**A.** TO QUESTION 249 — The motor will work correctly as long as you feed the current through the coils so that the magnetic flux will be correct.—H.S.

## Can you ANSWER these QUESTIONS?

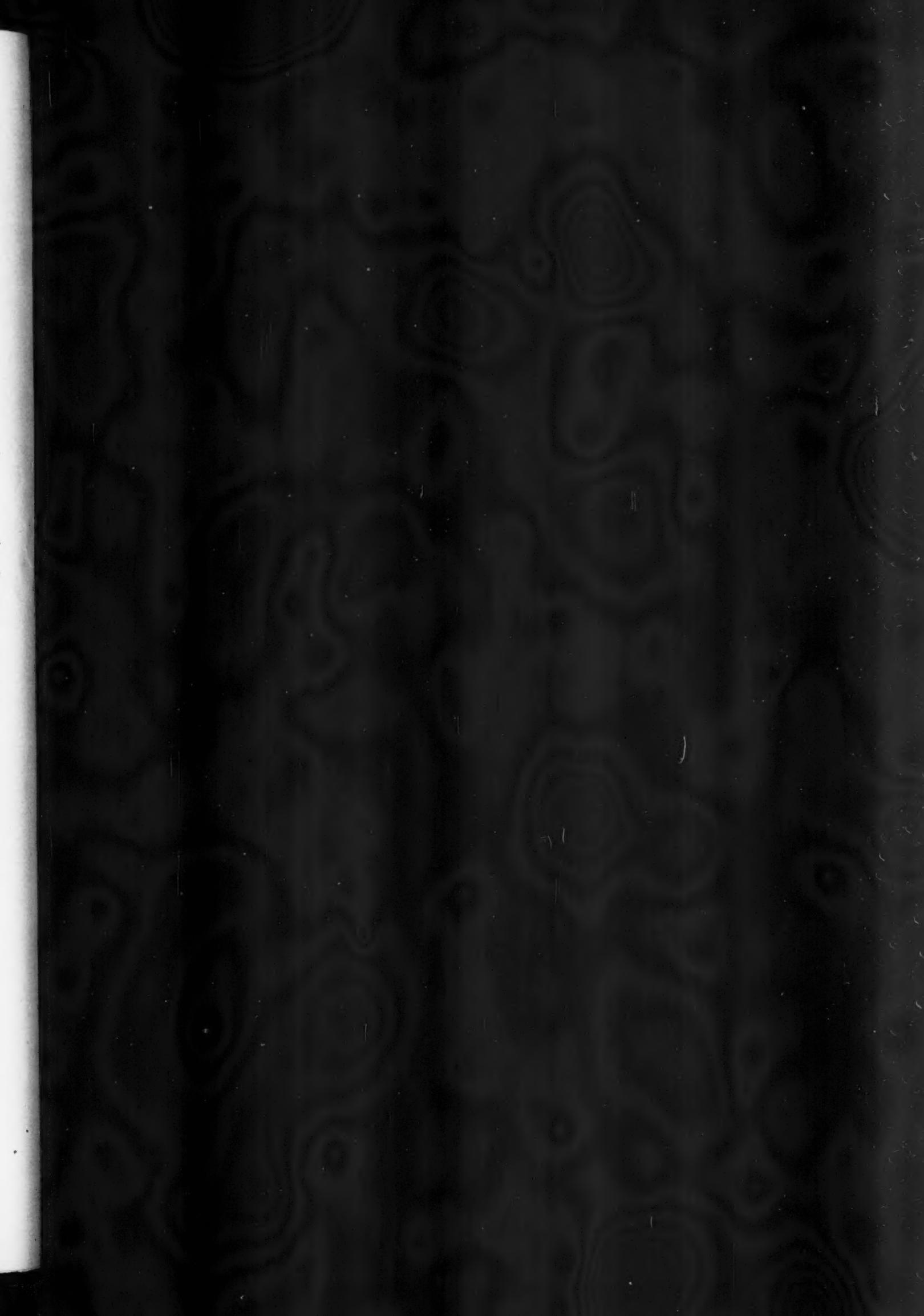
**QUESTION M11**—Not being able to obtain conduit and fitting, I installed a 60 amp. service with entrance cable and ran into the office of a garage. The power company made the service hot and then the inspector did not pass it.

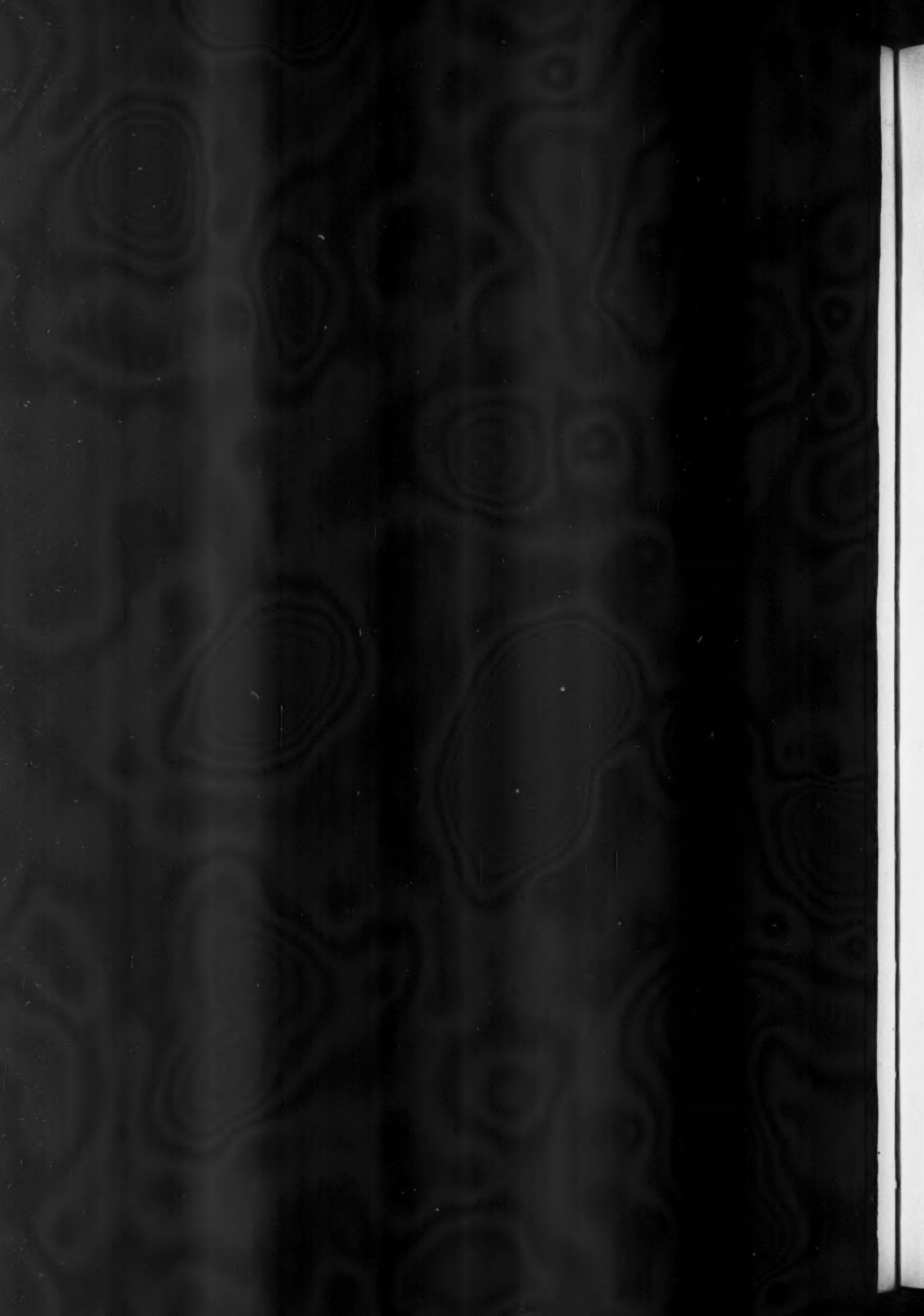
The 1940 Code book says not all parts of a building are necessarily hazardous so that the garage office could not be considered a hazardous location, could it?—V.E.T.

**QUESTION N11**—What would cause a 4000/2000 ampere 2/12 volt plating generator to have an unbalance of current division between the two commutators of this one generator with one common field. That is the brush rigging on side of the generator seems to give more current than the other side with which it is paralleled. What is the remedy?—E.K.

**QUESTION P11**—Running across some "supposedly" transformer oil in unmarked containers recently, we ran a flash test on it. The "flash" test showed the oil up to standard, however, the oil did not look right or feel right, so consequently was not used. Are there any further simple tests, such as mineral or vegetable base tests, without running a complete chemical analysis, that would determine if doubtful oil is actually transformer oil, or is the "flash" test enough?—L.R.D.

PLEASE SEND IN  
YOUR ANSWERS BY JULY 15





# Motor Shops

## Seating Brushes In Small Motors

Shop operators are undoubtedly familiar with the old method of seating brushes in fractional, and small integral horse-power motors. This usually meant fastening a piece of sandpaper (face up) around the commutator, mounting the brush end-bell, raising the brushes to rest on the sandpaper, and rotating the end-bell by hand so the brushes would assume the same curvature as the commutator.

A notable improvement over this practice was developed by W. Bryan Kelly of the Tennessee Electric Motor Service, Nashville motor repair shop specializing in small motor service. The idea was submitted in last year's NISA Award Contest and recently released for publication by NISA headquarters.

Kelly's device, while embracing the same basic principle of sanding the brushes, has an improved practical approach. Instead of using the actual motor commutator, he employs a sanding wheel (the same size as the commutator) that is set-screw positioned on a shaft belt-driven by a slow speed motor (see Fig. 1). The shaft revolves in two pillow blocks mounted to a bench top. On an extension of this shaft (in front of the sanding wheel) is a bushing which fits inside the brush end-bell bearing. The end-bell is simply pushed on this bushing and the motor started. The revolving sanding wheel seats the brushes perfectly and in record time.

Several wood disks, with sandpaper glued to them, are made the same size as the various commutators encountered in shop repair work. Shaft bush-

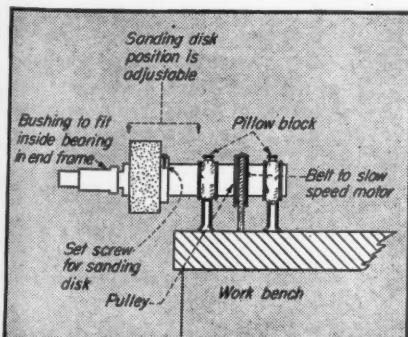


FIG. 1—Motor driven sanding disc used for seating brushes on fractional and small integral horsepower motors.

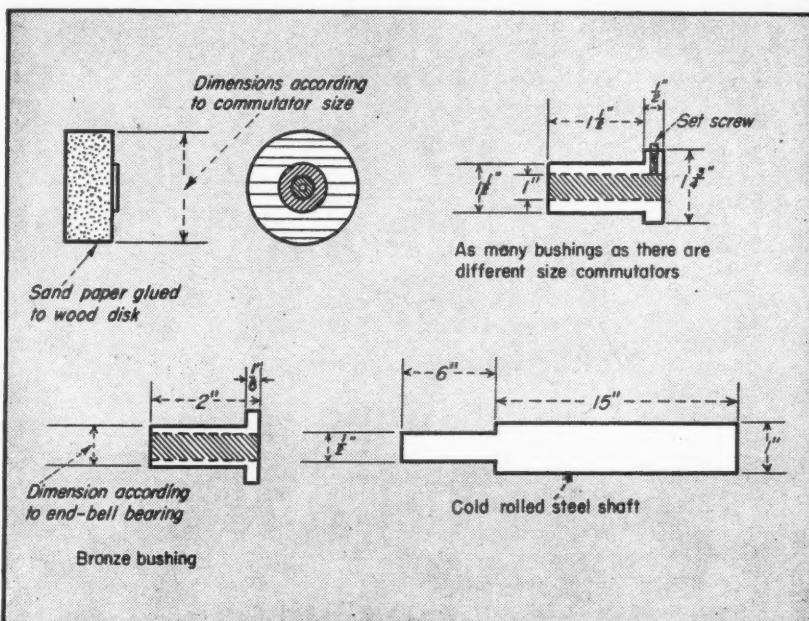


FIG. 2.—Details of sanding disc, shaft and brushing construction.

ings are also made to fit the different size bearings used.

The results obtained and labor saved bear out the recommendation that this device be considered by all shops specializing in or doing a considerable amount of single-phase and direct current motor repairs.

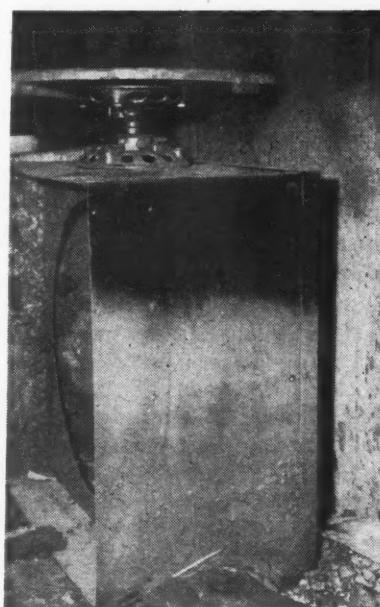
little grease was added to the motor shaft hubs, bearing point between the stationary bell and the revolving bell which supports the wood wheel.

Small objects being painted sprayed are placed on the rotating table, which can be easily rotated by hand as the paint is applied. It can also be used for many other jobs than painting, such as for assembly work.

## Handy Turntable From Old Parts

A turntable makes painting of small motors and parts an easy job, when using a spray gun. Employees at Alldritt Electric Motor Co., Miami, decided such a device would save time, and make work easier so they proceeded to make one from some old parts lying around the shop.

A heavy steel housing for a 30-inch blower fan was recovered from their scrap pile, to serve as a bench or table. Two bell ends from old motors, some  $\frac{3}{4}$ -inch board, and a few bolts were also recovered. A short pipe nipple was used to hold the two bells together, with the motor shaft hub of one resting on that of the other. The flared end of one bell was bolted to the makeshift bench top, while a two-foot diameter wheel was made of the  $\frac{3}{4}$ -inch boards and bolted to the flared end of the other bell. A

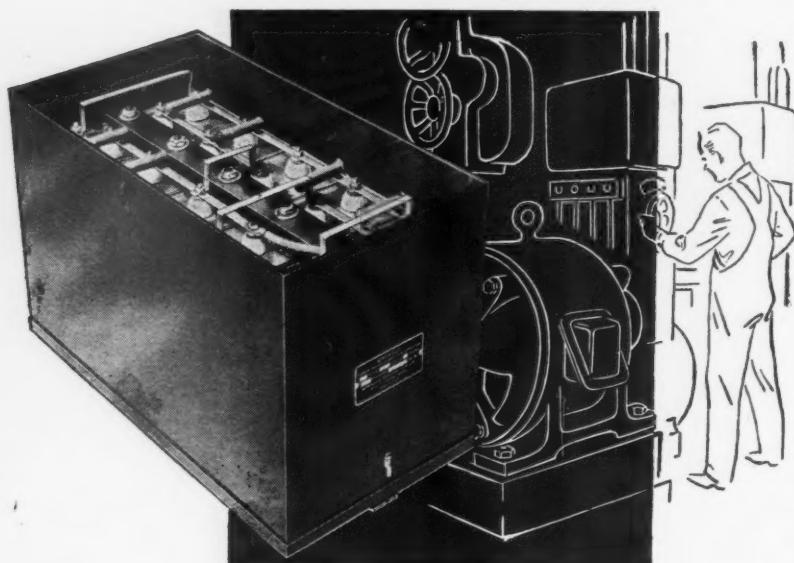


Handy turntable was made from scrap parts by employees of Alldritt Electric Motor Co., Miami, Fla.

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In an efficient service organization devoted to the maintenance and repair of motors and transformers, modern methods and modern equipment for expediting and improving shop and field routines are essential where maximum economies are to be realized. George R. Lockwood's Electric Motor Service shop, Trenton, N. J., applies this truth to every shop operation used in the reconditioning of a wide variety of electrical equipment.

To loosen the insulating varnish of damaged stator coils, the frames are placed on a slotted, rolling steel work table. The slot in the table top fits around a low-pressure gas-fired burning unit that projects from the rear wall of a metal, fireproof, vented booth. While coils are being fired, the hinged front of the booth may be folded down, excluding heat and fumes from other areas in the shop. When it is necessary for a man to work in this enclosed area, the height of the booth is great enough to permit standing upright and the vented hood insures the elimination of odors from the confined space. (Fig. 1).

Burned coils are pulled from stators by a Schrader compressed air unit. The unit consists of a compressed air chamber, a piston which is driven downwards when air is admitted to the top of the cylinder, a vertical shaft fitted with a sturdy hook and guiding hand lever, and an activating



FIG. 1. To loosen damaged stator coils, the unit is placed on a slotted work table which is rolled into a vented booth. The slot in the table top fits around a low-pressure gas-fired burning unit. Hinged front of the booth may be lowered to confine heat and fumes to local area.

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FROM THE MEN ON THE JOB**

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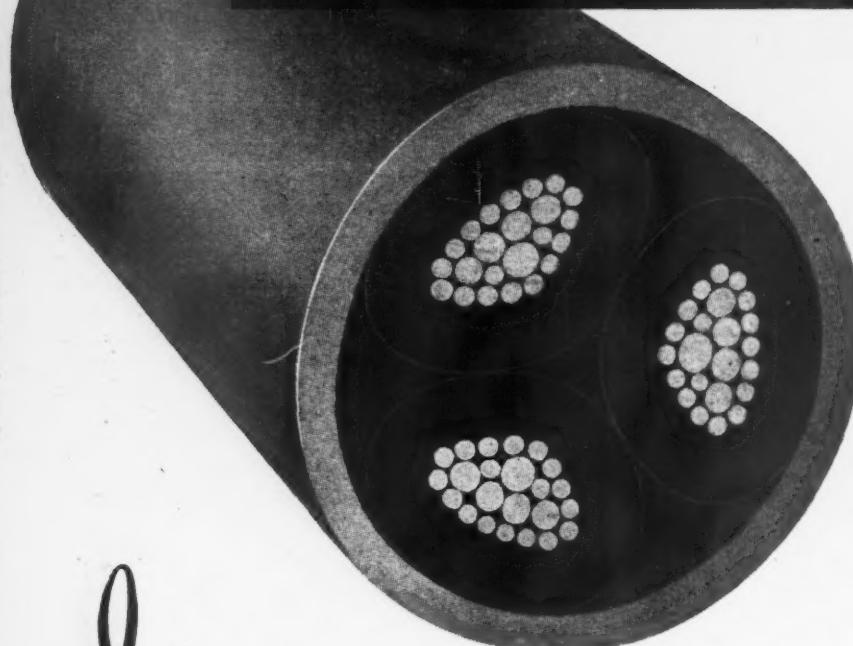


Now you can put an end to the annoying need for specifying several types of bar hangers. The General Electric S-type bar hanger fits anywhere, goes in place easily where studs are on centers up to 24 inches. Users say the General Electric S-type hanger speeds and simplifies box installation.



For wiring flexibility in concrete office buildings, plants, hospitals, and for other construction jobs where provisions must be made for varying wiring needs, look into the advantages of Fiberduct underfloor raceways. These nonmetallic, corrosion-proof ducts permit installation of new outlets anywhere in the duct at any time. Buildings equipped with Fiberduct stay electrically young. See us for details.

# SIMPLEX VARNISHED CAMBRIC CABLES / *for high Temperatures*



**I**F you must run cables through rooms that are hot, or if you must run your conductor temperatures high, you can save money and get dependable service by installing Simplex Varnished Cambric Insulated Cable.

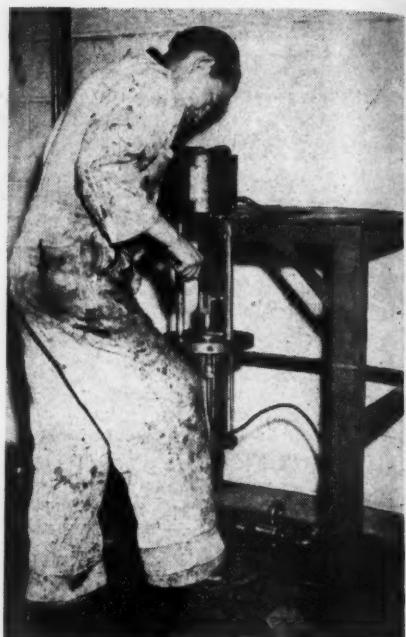
Simplex Varnished Cambric Insulation will stand up longer than other types under such conditions. It will stand large temporary overloads and sudden voltage surges without becoming damaged.

Simplex Varnished Cambric Cables for boiler room and other high temperature service are regularly furnished with a braid for outer covering.

When you next need a heavy power cable for high temperature service, a Simplex engineer will be glad to tell you whether a Varnished Cambric Cable will fit your conditions.

## Simplex-WIRES & CABLES

SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST. CAMBRIDGE 39, MASS.



**FIG. 2.** Coils are quickly and cleanly pulled by a hand-guided vertically-moving hook which operates with 130 pounds of air pressure. Movement of hook is dependent upon air pressure which in turn is regulated by pressure on a foot pedal. Notched table assembly was constructed in the shop.

foot pedal. Air valves are controlled by this foot pedal, directing air at 130 pounds pressure through a metal tube to the top of the cylinder when the pedal is depressed and permitting the air to escape and the piston to return to the top of the cylinder when foot pressure is relieved. Varying foot pressure can increase or decrease the speed of the piston or can hold it stationary at any desired level. The unit is mounted beneath a shop-constructed steel table, the 5/16-inch top being notched directly over the compressor. In operation, the stator, with severed coil ends placed upwards, is rested on the table and the rising hook is guided to the various coils by means of the hand lever. Coils are pulled quickly and cleanly from their slots when the foot pedal is depressed and the piston is forced downwards. (Fig. 2).

After thoroughly baking the newly wound stators, the units are dipped in a floor-recessed cold varnish tank. Small units are raised and lowered on a rack suspended from an overhead chain hoist. When larger units are dipped, the rack is lowered to the bottom of the tank. When not in use, the tank is covered by a hinged steel cover. The buried tank occupies a minimum of shop space, permits a low and convenient working level and eliminates the possibility of leaking or spillage. (Fig. 2).

Employees of the Lockwood organization are encouraged to submit suggestions for improving shop tasks,

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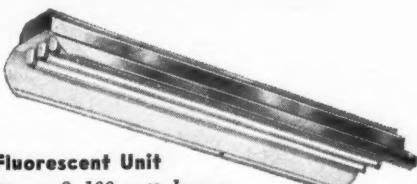
\*Just a shade too dark  
slows down production.

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turers have found that Skilled Lighting pays for itself many times over in fewer rejects, higher employee morale and increased production.

Make a light meter check in your plant now. If the results show Borderline Vision, see what a difference Wheeler Skilled Lighting will make in your profits. Write Wheeler Reflector Co., 275 Congress St., Boston 10, Mass. Also New York and principal cities.

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All-Steel Fluorescent Unit

For 2 or 3 40-watt, or 2 100-watt lamps.  
Available with open or closed end porcelain enameled reflectors. Broad wiring channel with accessible enclosed ballast.  
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Expertly designed, ruggedly built. Vitreous enamel only.  
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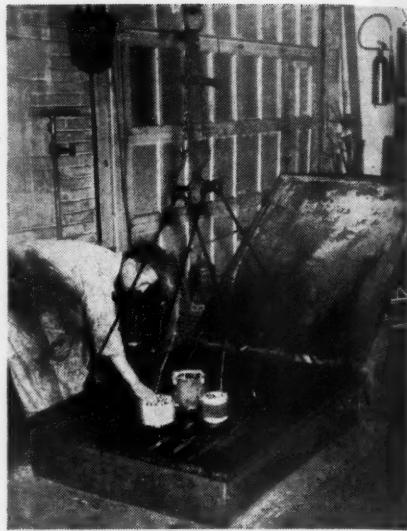


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WIRE AND CABLE



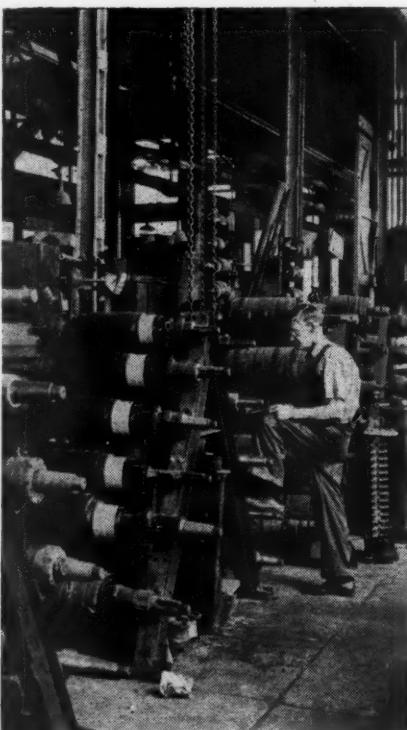
**CRESCENT INSULATED WIRE & CABLE CO.**

TRENTON, N. J.



**FIG. 3** Cold varnish dipping tank is recessed into floor to minimize occupied shop space, to create a convenient working level and to eliminate the possibility of leaks. Chain hoist raises and lowers frame upon which small units rest and moves larger units between tank and baking oven.

and constant attention, study and analysis of the methods and procedures of other progressive motor shops (as discussed in the trade press, presented at NISA conventions and observed during personal visits to friends in other cities) is devoted in the interest of increasing shop know-how and efficiency.



**Bill Williams, Sculin Steel Company's** oldest (in point of service) motor rewinder, and racks of quickly available armatures. Spare Fiberglas rewound armatures are stocked for virtually every motor, making it possible to change an armature anywhere in the mill in less than an hour's time.

Answered by  
**F. N. M. SQUIRES** and **GLENN ROWELL**  
New York Board of Fire Underwriters  
Chief Inspector  
New York, N. Y.  
Electrical Engineer  
Fire Underwriters Inspection Bureau  
Minneapolis, Minn.

# Questions on the Code

## Fixture Channels As Raceways

**Q.** In the past I have installed two or three circuits using a common neutral in the raceways of continuous fluorescent lighting fixtures.

Under section 4150 of the 1947 Code it states that a single circuit may be carried through a continuous raceway. Is this an ambiguous statement or is the interpretation of the Code such that two or three circuits with a common neutral may be run in an approved continuous fluorescent fixture raceway?—W.L.B.

**A.** Underwriters Laboratories list about four makes of raceways which may be used as both raceways for wires and as fixture channels with incandescent or fluorescent lampholders mounted in or on the raceways and with the fluorescent ballasts mounted on or in the raceways or in separate enclosures as stated in each case in the Laboratories' listing. The Laboratories also list the maximum number of wires for the various size raceways.

Unless listed as raceways, fixture channels may contain only the wires of the circuit to which the fixtures are connected.

As to the use of a "common neutral" if the incoming service is a two wire one only two wire circuits may be employed and it is not permissible to place two or more circuits on a common neutral.

If a 3 wire service is used, of course a 3 wire circuit may be employed, but not more than one such circuit may be used on a single neutral.—F.N.M.S.

## Taps

**Q.** Is it permissible to run a feeder to handle a group of motors with a tap extending from the feeder to each motor without providing

overcurrent protection at the point where the tap is made to the feeder run? The longest tap is 30 feet and the shortest is about 9 feet long.—C.K.

**A.** Taps which have at least one-third the current carrying capacity of the feeder and are not more than 25 feet in length need not be provided with over-current protective devices at the point where the smaller conductor is attached to the feeder providing it is suitably protected against mechanical injury and terminates in an overcurrent protective device which will limit the load on the tap to that allowed by the current carrying limits contained in Tables No. 1 and 2. This ruling will be found in Section 2434d.—G.R.

## Wiring for Paint Spraying

**Q.** When wiring a room in which spray painting is done within a metal booth, we plan to use ordinary two lamp 100 watt fluorescent fixtures mounted above wire glass panels built into the top of the booth. However, upon examining the booth, we found that it came equipped with two vapor-tight incandescent fixtures mounted on the top of the frame at the open end of the booth in such a manner that they extended out into the room but directed their light into the booth. Now we wonder if the fluorescent fixtures must also be vapor-tight and also if it is proper to leave these fixtures at the open end even though they are not separated from the spraying operations by wire glass.—R. C.

**A.** The Code now lists paint spraying by itself under Section 5003 as the hazards present are different from those classified as Class 1 or 2. Subsection (a) of this special section states that "No electrical equipment or apparatus shall be installed or used in any location where readily ignitable

residues may be deposited except that wiring in rigid conduit or in boxes or fittings containing no taps, splices or terminal connections may be installed in such location." This obviously makes it necessary to study each individual installation separately as it is likely that operations will differ considerably. In your case, will the spraying operations be such that paint residue is likely to gather on the vapor-tight fixtures? If it does, they should be removed or separated by a wire glass panel. In subsection (b) permission is granted to use the wire glass panels, and here it states that the fixtures used shall be of the type approved for use in the room in question. Therefore if there is no paint mixing, dipping or storage of flammable liquids outside the booth and there are no other possible sources of flammable vapors or dusts, ordinary fixtures may be used to direct the light through the wire glass panels into the booths.—G. R.

## Lighting Circuits

**Q.** Our inspector has told us that we can no longer use common neutrals on our lighting circuits unless the dwelling is served by 110-220 volt service and then we might use not more than two hot wires with each neutral. Is this a Code rule?—P. R.

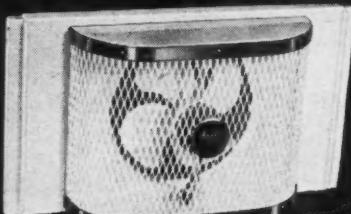
**A.** Yes, Section 2111 of the N. E. Code states that the ungrounded conductors of a multi wire circuit must have a potential difference between them. Therefore a building served by a two wire 115 volt service cannot be wired with a common neutral for two or more branch circuits. In a building supplied by a three wire 115-230 volt service you might install a common neutral with not more than two ungrounded conductors and those conductors would have to have a voltage between them of 230 volts.—G. R.

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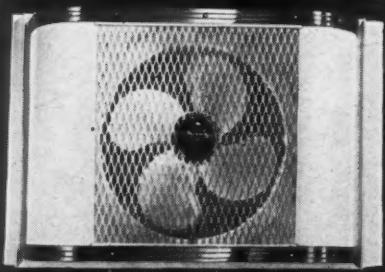
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## Number of Circuits Required

**Q.** Rule 2115 of the 1947 Code states that one or more branch circuits of No. 12 wire shall be used for the small appliance load in kitchen, laundry, pantry, dining-room, etc. of dwellings. What would determine the number of these circuits so that the inspector would pass it?—F.R.B.

**A.** The receptacle circuit referred to above, as it is of No. 12 wire, may be fused at 20 amperes and is therefore a 20 ampere circuit on which the maximum permissible load, is 20 amperes, therefore one such circuit will suffice unless the load exceeds 20 amperes in which case, another circuit will be required.

As to the total number of circuits required in a dwelling occupancy, let us give the following information:

The Code in Section 2115 requires that in such an occupancy the lighting and appliance load shall be computed on the basis of 2 watts per square foot of floor area and in Section 2115 requires that the number of circuits be determined from this computed load. That is, this computed load divided by the capacity of circuits to be used, would give the number of circuits required. This last statement is not quite true for small houses inasmuch as Paragraph b of Section 2115 requires that at least one No. 12 wire circuit be provided to supply the appliances in the kitchen, laundry, pantry, dining-room and breakfast room and that no other outlets be connected to this circuit. Thus a minimum of two circuits must be provided, one, the above appliance circuit, the other for the other outlets in the house.

Now let us see how much area two circuits can supply on the basis of 2 watts per square foot.

If we fuse both of our two circuits at 15 amperes and thus call them 15 ampere circuits, we have  $2 \times 15$  amps.  $\times 120$  volts, equals 3600 watts, and 3600 watts divided by 2 watts per sq. ft. equal 1800 sq. feet.

Or, if we rate the No. 12 wire appliance circuit as a 20 amp. branch circuit and the other circuit as a 15 amp. one, we have

20 amps.  $\times 120$  volts equals 2400 watts plus

15 amps.  $\times 120$  volts equals 1800 watts

a total of ..... 4200 watts and 4200 watts divided by 2 watts per sq. ft. equal 2100 sq. ft.

Therefore the Code requires at least two circuits in a house which has a floor area up to 2100 sq. ft.

However, the Code has a recom-

TAPES THAT ARE TOPS . . .

in ELECTRICAL  
STRENGTH\*

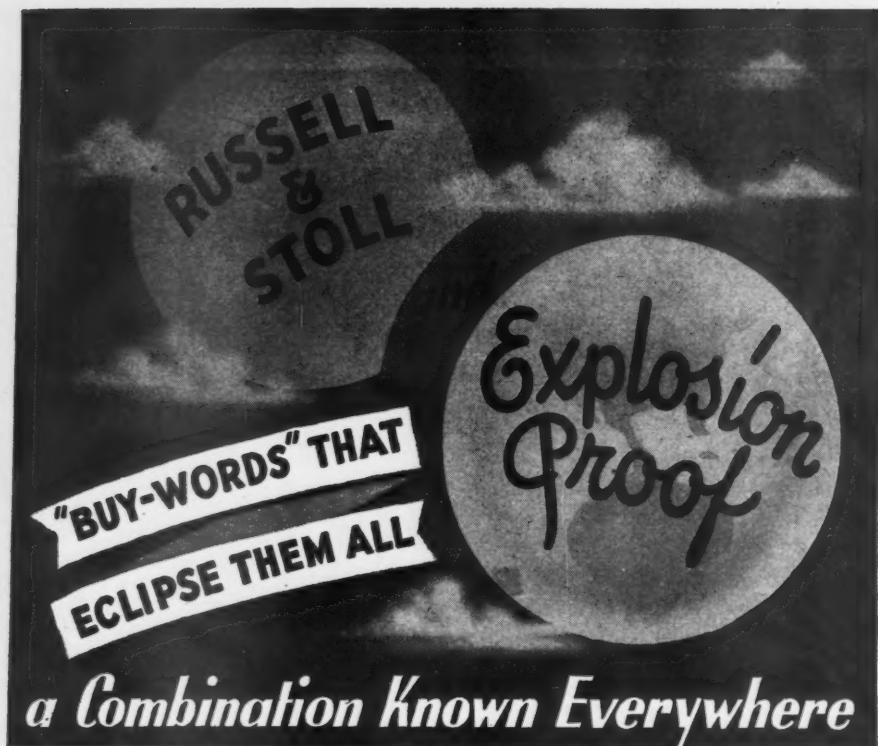


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recommendation following Rule 2115 which is one that should be recognized and that is, that one 15 amp. branch circuit be installed for each 500 sq. ft. of floor area for general illumination. Less than this, might present no undue hazards, but would at least be poor engineering.—F.N.M.S.

## Solder Lugs

**Q.** Is it true that solder lugs for terminal connections are no longer permitted by the Code?

—J. A. N.

**A.** No, except on service equipment. Under Section 2358 of the N. E. Code you will find the following rule: "The service conductor shall be attached to the disconnecting means by pressure connectors, clamps, or other approved means, except that connections which depend upon solder shall not be used." Section 1117 relating to connections to terminals still recognizes solder lugs as an acceptable means of terminal connection in general.—G. R.

## Residential Wiring

**Q.** We have been told that the Code will not permit the installation of a convenience outlet in the dining room of a dwelling unless it is attached to the appliance circuit. Now if the owner wishes table or floor lamps in this room, can they be plugged into the appliance circuit outlet even though that circuit is protected at 20 amperes?—R. H. F.

**A.** No. Strict interpretation of the Code not only will prohibit such use of the receptacles supplied by the appliance circuit when provided with overcurrent protection rated at 20 amperes, but also will not permit extending another circuit to supply ordinary convenience outlets for such lamp supply. This portion of the Code is an excellent subject for an official interpretation by the Code Committee, as the only alternative a contractor has now is to limit the overcurrent protection on the appliance circuit to 15 amperes.

Section 2115b states that all receptacle outlets in the dining room must be connected to the appliance circuit and Section 2123 states that only heavy duty lampholders can be supplied by a 20 ampere circuit with the two exceptions which permit connec-

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tion of medium based lampholders of the porcelain unswitched type or permanently fixed fixtures for fluorescent lamps.

This brings forth the need for a receptacle for use on an appliance circuit which is of different design or appearance than the commonly used duplex convenience outlet. An adequately wired home certainly should provide ample capacity for modern appliances and portable lamps not only in the dining room but also in the breakfast room and kitchen in many instances. Section 2124b now requires a three pole type receptacle for the laundry, why not use that on all appliance outlets now that there are three pole receptacles available into which a two prong attachment plug cap can be placed.—G. R.

## Service Switch on Pole

**Q.** The Lighting Company in this locality has a new rule which states that they will only set one pole on private property at a maximum distance from the public road of 150 feet. The rule also requires that the meter and the main switch be mounted on this pole. From that point the rest is the owner's responsibility.

My problem is, as the main switch is mounted on the pole is another switch required in the dwelling?—H.L.G.

**A.** The Code in Section 2351 requires that each set of service entrance conductors be provided with a disconnecting means and that this be located at a readily accessible point nearest to the entrance of the conductors either inside or outside the building wall.

While this rule does not specifically state that the service switch must be on the building wall, either inside or outside of the building, it seems to clearly imply that and also it seems that a location on a pole more than 10 or 15 feet away from the building certainly is not at a "point nearest to the entrance of the conductors" to the building.

The fact that the Lighting Company requires a switch on the pole does not change the requirement for a service switch to be located at the point of entrance although if the pole was within 10 or 15 feet of that point, probably no inspection bureau would object.

The Code does not require a switch on the pole even though the meter is located thereon where a single building is involved.—F.N.M.S.

# Announcing

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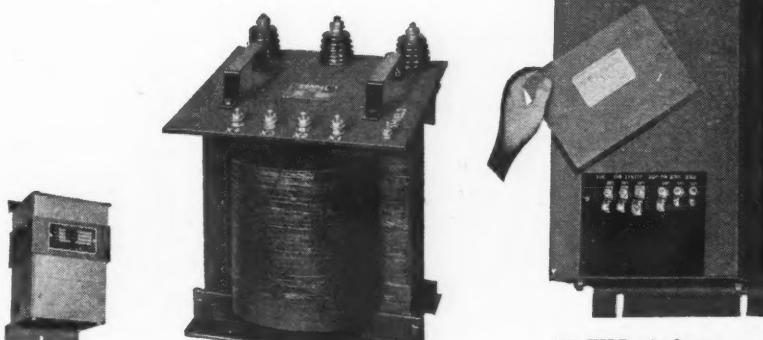
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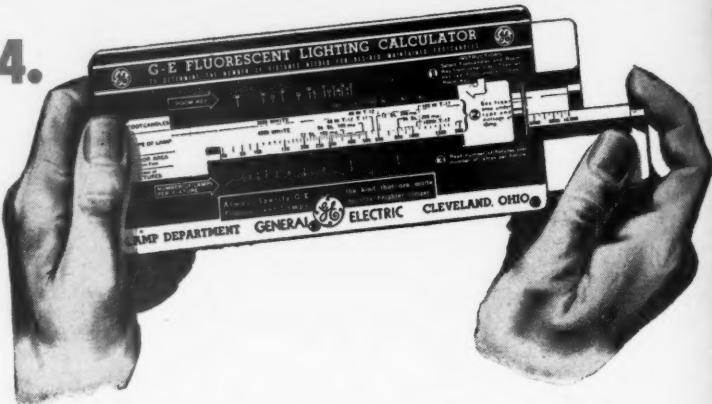
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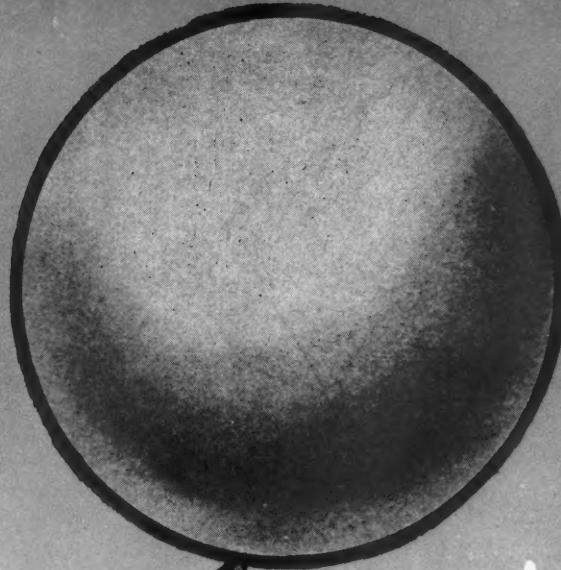
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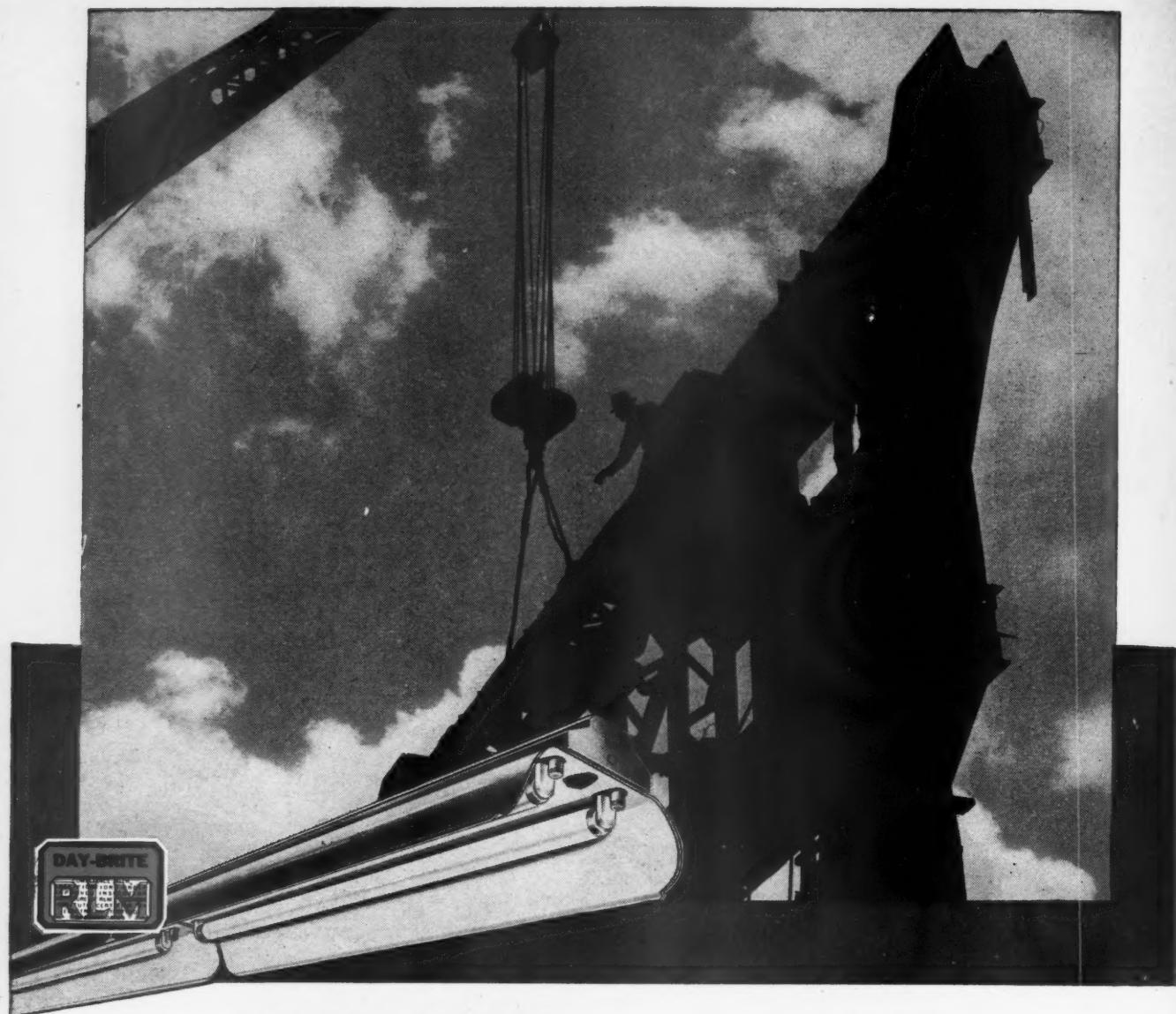


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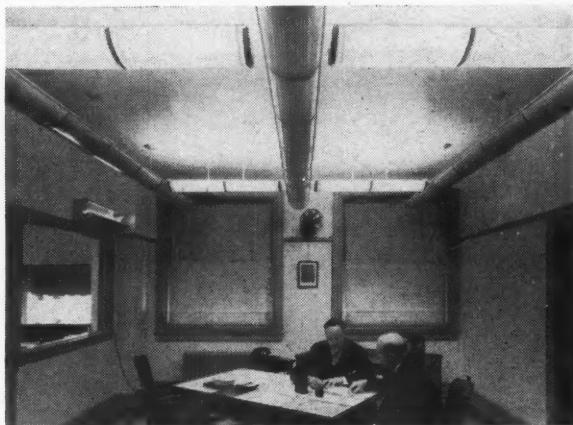
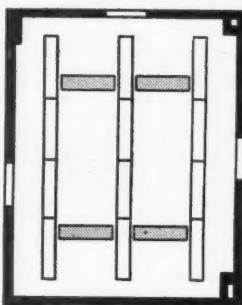
# Modern Lighting

## Dual Purpose Office Lighting

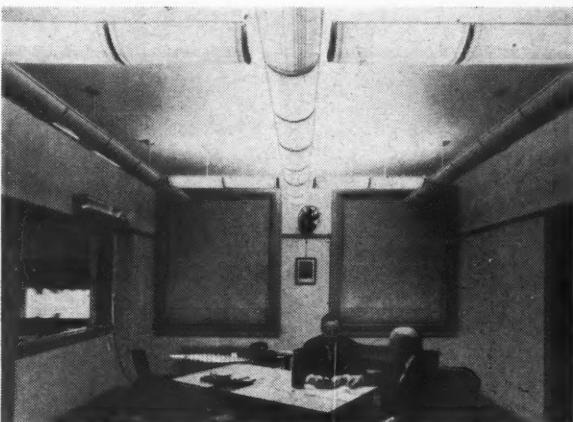
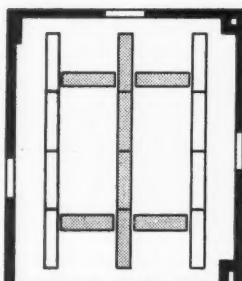
The best way to sell planned lighting is through demonstration. Most lighting customers already have some preconceived plan for solving their own lighting problems. A demonstration of the customer's solution on a full scale model basis, and of other possible solutions, usually results in the customer changing his mind and raising his own standard for lighting.

Working on this premise, R. F. Hartenstein of the Ohio Edison Co., Akron, decided to relight his own office so that it would serve as a demonstration room for various types of lighting layouts for office lighting. Now he has lighting of the amount and quality to meet his own requirements, and also an installation with flexibility of lighting effects, made possible through proper selection and location of lighting equipment, and multiple switching control, which will permit demonstration of good and bad lighting practice.

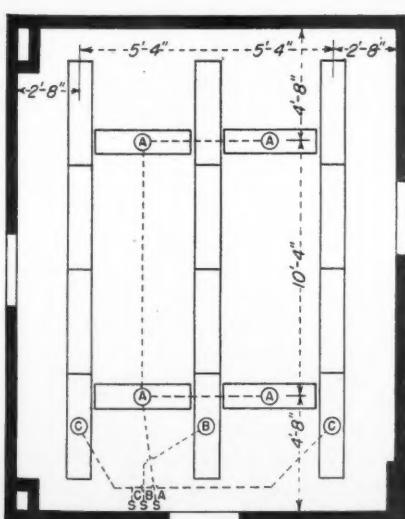
The office is 16 feet wide and 19 feet 8 inches long. Sixteen individual Wakefield Star units, each equipped with two 40 watt fluorescent lamps, were used to obtain the lighting flexi-



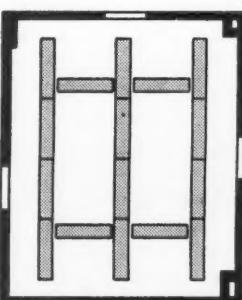
Wall switch A controls four individual units which produce 21 footcandles, typical of "outlet for outlet" replacement in relighting jobs.



Wall switch B controls center continuous row. Combined with the four individual units, 41 footcandles result. Ceiling is unevenly lighted.



Lighting layout for private office of R. W. Hartenstein, Ohio Edison Co., Akron, Ohio. Three wall switches provide flexible system of control to produce seven different combinations and lighting results.



Wall switch C controls the two outer continuous rows. With all units lighted, 85 footcandles of light results, but ceiling is too bright for comfort.



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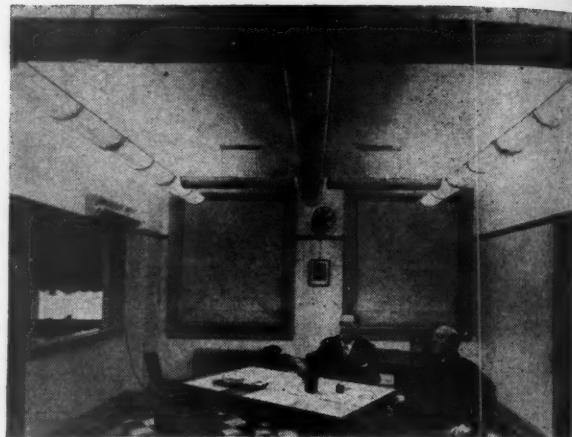
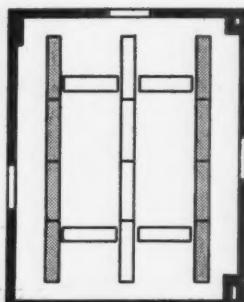
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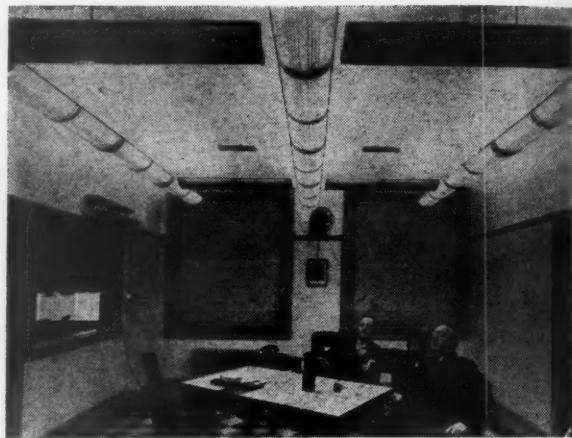
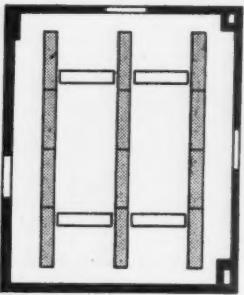
Architectural and Engineering Files for 1947

\*Trade Mark Registered U.S. Pat. Off.

**GENERAL**  
LUMINESCENT CORP.  
672 S. FEDERAL STREET • CHICAGO 5, ILLINOIS



With the two outer rows only lighted, unbalanced lighting results due to wide spacing. Note dark ceiling in center.



Best combination and lighting result is obtained with the three continuous rows lighted. Lighting level with this combination is 65 foot-candles.

bility desired. These are arranged in three continuous parallel rows of four units each, installed lengthwise in the room, and four individual units installed normal to the continuous rows. Three wall switches are used to control these units, which permits seven separate combinations and lighting effects. The Star unit is of the luminous-indirect type, and is installed with the bottom of the units 18 inches from the ceiling.

Mr. Hartenstein has kept the color of the ceiling and side walls in his office-laboratory plain and simple, so that it is fairly typical of that found in the average office of most customers. He keeps his light meter on his desk, ready to use at any time when any customer comes in to discuss lighting quality, intensity, comfort, brightness, layout or other factors.

One wall switch (A in Fig. 1) controls the four individual units. It permits demonstration of typical symmetrically spaced individual units. The intensity from these four units is 21 footcandles. The general effect is insufficient light for offices, an unevenly lighted ceiling, and considerable varia-

tion in intensity and brightness.

The second wall switch (B in Fig. 1) controls the center continuous row fixtures. When this fixture and the four individual units are lighted, 41 footcandles are obtained, but the ceiling still remains unevenly lighted, and there is considerable contrast between the brightness of the ceiling and side walls. Use of the center row only does not give enough light, and results in excessive variation of intensity throughout the room.

The third wall switch (C in Fig. 1) controls the two outer rows of fixtures. With these two units lighted, added to the center row and the four individual units, the lighting intensity increases to 85 footcandles. This combination is considered too bright to be comfortable by many who have seen the demonstration, due in part to the excessive ceiling brightness contrasted with the brightness of the side walls.

A combination which pleases most customers is the use of the three continuous rows of units. It produces 65 footcandles, the ceiling is fairly evenly lighted, and there is a minimum of brightness contrast.

**“Sir, you are speaking  
of the industry I love!”**



**Here's the challenge one  
utility executive directs at  
fluorescent lighting fixtures:**

 "I wish the manufacturers of fluorescent fixtures would cut out the claims and counter-claims and get down to business with some facts and useful information. I wish they'd be frank with us." Those sound like "fightin' words" but CERTIFIED FLEUR-O-LIERS provide a ready short-cut for wholesalers, contractors, utilities AND users.

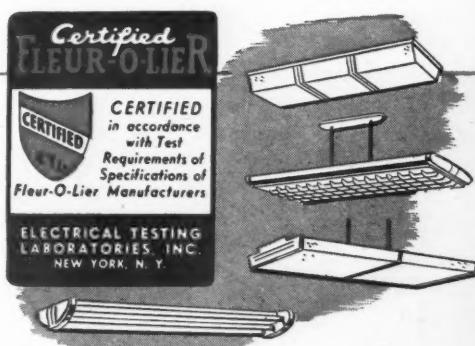
**And  
here's the quick answer that  
simplifies the problem:**



CERTIFIED FLEUR-O-LIERS are made by 27 leading manufacturers. Although each manufacturer creates his own styling and design, basically the CERTIFIED FLEUR-O-LIER fixtures are made to *exacting specifications* for electrical and mechanical excellence . . . plus good lighting performance. They are tested, checked and CERTIFIED by famous Electrical Testing Laboratories, Inc., as meeting all specifications. That's why the CERTIFIED FLEUR-O-LIER Label on a fixture is all you need to assure you—without exaggeration—of top quality in fixtures.

## **FLEUR-O-LIER** *Manufacturers*

Fleur-O-Lier is not the name of an individual manufacturer, but a group of 27 leading fixture manufacturers. Participation in the FLEUR-O-LIER MANUFACTURERS' program is open to any manufacturer who complies with FLEUR-O-LIER requirements.



INDIVIDUAL CONTROL  
by  
**McGILL**  
*Levolier* SWITCHES

**ADDS TO LIGHTING LIFE . . .  
INCREASES THE EFFICIENCY  
OF ELECTRICAL DEVICES**

Sturdy . . . dependable . . . inexpensive **McGILL LEVOLIER SWITCHES** give you **SELECTIVE CONTROL** over all lighting fixtures . . . permitting "time-out" periods that **ADD TO LIGHTING LIFE . . . SUBTRACT FROM POWER COSTS.**

Easily adapted to variable speed motors, ventilating fans, sign flasher boxes, and transformers, **LEVOLIER SWITCHES** provide **CONVENIENT, POSITIVE CONTROL** where control is often otherwise inaccessible. Economize on power . . . cut maintenance . . . and **INCREASE** lighting-life and electrical efficiency with **LEVOLIER INDIVIDUAL CONTROL**. Model 41, 6 amp. pull switch, is shown above.

**SPECIFICATIONS**

Cat. No.	Stem Diam.	Stem Length
41	7/16	3/16
41PL	7/16	3/16
41B	7/16	7/32
41BPL	7/16	7/32
42	7/16	3/8
42B	7/16	13/32
43	7/16	3/4

**ONLY McGILL MAKES**  
*Levolier* SWITCHES

**McGILL**  
MANUFACTURING CO., INC.  
Electrical Division  
VALPARAISO, INDIANA



Four 1000 watt enclosed floodlights installed behind the columns provide impressive floodlighting for the entrance of the Cathedral Church of St. Paul, Boston.

### Church Floodlights Entrance

Floodlighting serves a double purpose at the Cathedral Church of St. Paul in Boston. The utilitarian use is to provide ample illumination at the main entrance for safe entrance and exit, with the light sources adequately concealed. The other use is esthetic, to silhouette the large columns and accent the architectural beauty of the entrance and building front.

A simple plan was used to solve this lighting problem. Four 1000 watt floodlights of the enclosed type, Benjamin RD-18 with clear glass covers, were installed on the ceiling over the entrance portico, one unit behind each

of the four large center columns. Inside frost standard lamps were used, which made it unnecessary to use stippled or diffusing glass lenses in the floodlights. Beam spread adjustment and adjustable mounting bases on each unit permit flexibility ample to provide a uniform lighting intensity on the church wall inside the portico and behind the columns.

This installation was planned by the Lighting Section, Technical Service Division, Boston Edison Company, and installed by the Edw. G. Sawyer Company, electrical contractors, Boston, Massachusetts.



New lighting and air-conditioning have been installed in the recently enlarged drafting room of The Austin Company's Cleveland District, used by more than 150 designing engineers. It has been found that these improvements have materially reduced eye-strain and bodily fatigue. Recessed louvered fluorescent troffer units of the two-lamp 40 watt continuous row type were installed on three-foot centers, extending the length of the room between the welded rigid frame arches. Mounting heights range from 13 feet near the outsides of the 70 foot span to 22 feet at the peak of the arch. Each four foot length of troffer is equipped with one daylight and one soft white 40 watt fluorescent lamp. An exceptionally uniform intensity of over 90 footcandles of well-balanced color quality is maintained on the drafting tables. The troffer units were supported from the purlins, and the metal acoustic ceiling in turn is supported by the lighting fixtures. Lower wall areas are painted in graduated shades of soft gray-blue, with a neutral "Caen-Stone" shade on the upper walls.

# PRE-WAR PRICES... *Poppy-Cock*

Never before have such values been offered  
in Westinghouse Lighting Equipment

## HERE ARE THE FACTS

### *Quality*

The construction and performance of 1947 Westinghouse lighting equipment is even better than that of 1940, because Westinghouse production techniques and design have been improved constantly to give more attractive and efficient units.

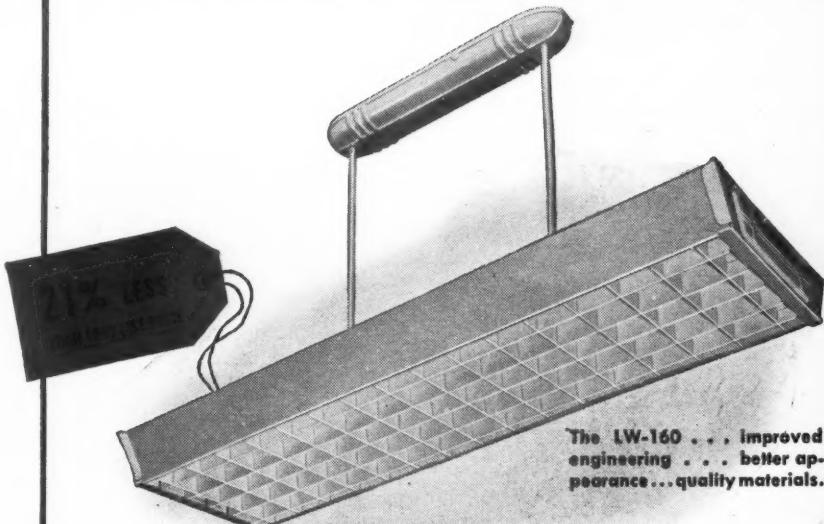
### *Results*

Westinghouse Planned Lighting can increase production, lower manufacturing costs, improve employee morale, reduce accidents, raise quality of product... quickly pay for itself.

### *Price*

Take, for example, the four 40-watt, fluorescent-lamp, commercial unit. Present list price is 21% less than 1940, yet today's streamlined design gives better performance and is easier to install and maintain. Or the two 40-watt, fluorescent-lamp, industrial unit. Today's list price is 4% less, yet this unit has many improvements such as higher efficiency, enclosed ballast, better appearance, easier installation and maintenance.

It's a fact... proved by the record. Today's prices for Westinghouse lighting equipment offer one of the greatest values of the times. Results you get with Westinghouse Planned Lighting make such expenditures profitable investments.

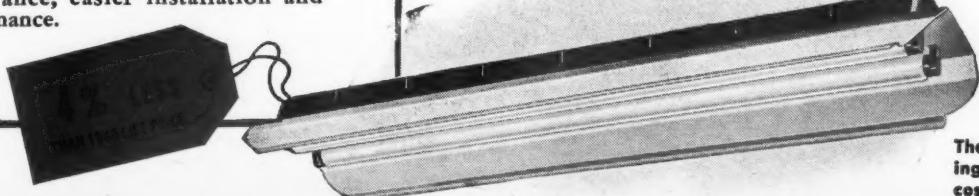


The LW-160... improved engineering... better appearance... quality materials.

Whether it's commercial, industrial or floodlighting; incandescent, fluorescent or mercury, you'll find Westinghouse quality, service and price give an outstanding value. You can get almost any fluorescent luminaire immediately out of distributors stocks, or within 30 days.

A call to your nearest Westinghouse office or distributor will quickly bring an engineer who will work with you in designing a Westinghouse Planned Lighting System; or write Westinghouse Electric Corp., P.O. Box 868, Pittsburgh 30, Pa.

J-04133



The FPR... high lighting efficiency... low first cost... low operating cost.

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# MULTI INDUSTRIAL LIGHTING UNITS



## Modernization Demands these Units

★ Modern methods of construction demand just as modern lighting units and MULTI is composed of units that will give you not only the most modern, but also the most efficient from a lighting and service standpoint. MULTI Lighting Units meet all present day needs whether it's outdoor or indoor, localized or general, fluorescent or incandescent installations. Better lighting is assured for your customers if you choose MULTI Industrial Units.

• Send for our complete catalog.



## MULTI

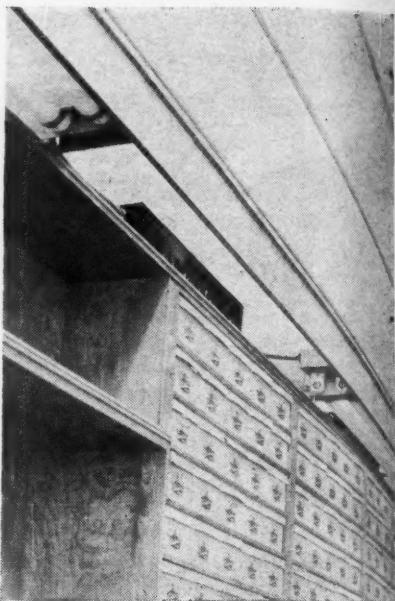
ELECTRICAL MANUFACTURING CO.  
4223 W. Lake St., CHICAGO 24, ILL.

## Shoe Store Lighting Problem

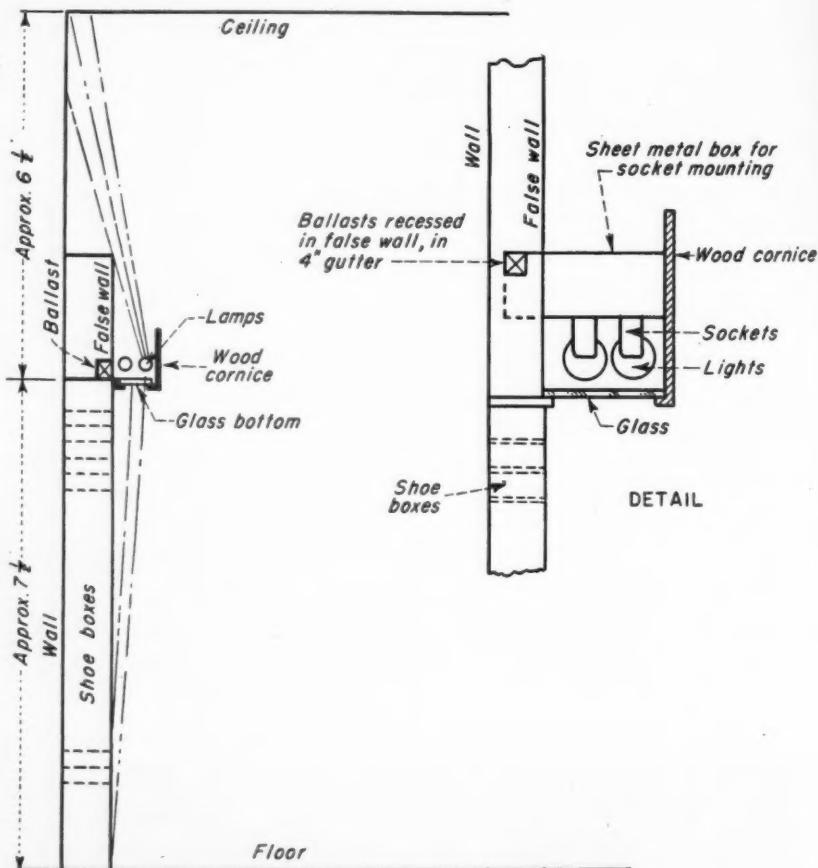
The Williams Shoe Store in San Diego, Calif., recently remodeled and redecorated, put the lighting problem up to the California Electric Works of that city. Standard methods were employed for general illumination, being incandescent lamps recessed in the ceiling and louvered. However, an individual problem was presented in connection with the shoe box stock arranged completely around three sides of the high-ceilinged room.

The fronts of the boxes were flush with a false wall immediately above them, about  $3\frac{1}{2}$  ft. in height and out from the main wall a distance equivalent to the length of the boxes. It was desired to put additional illumination on the box ends for easy reading and at the same time throw additional light upward onto the walls, supplementing the general illumination, but with no lamps showing from any part of the room.

This special down and up lighting was accomplished as shown by the sketch and photographs. No fluorescent fixture was manufactured that would permit light to be thrown both

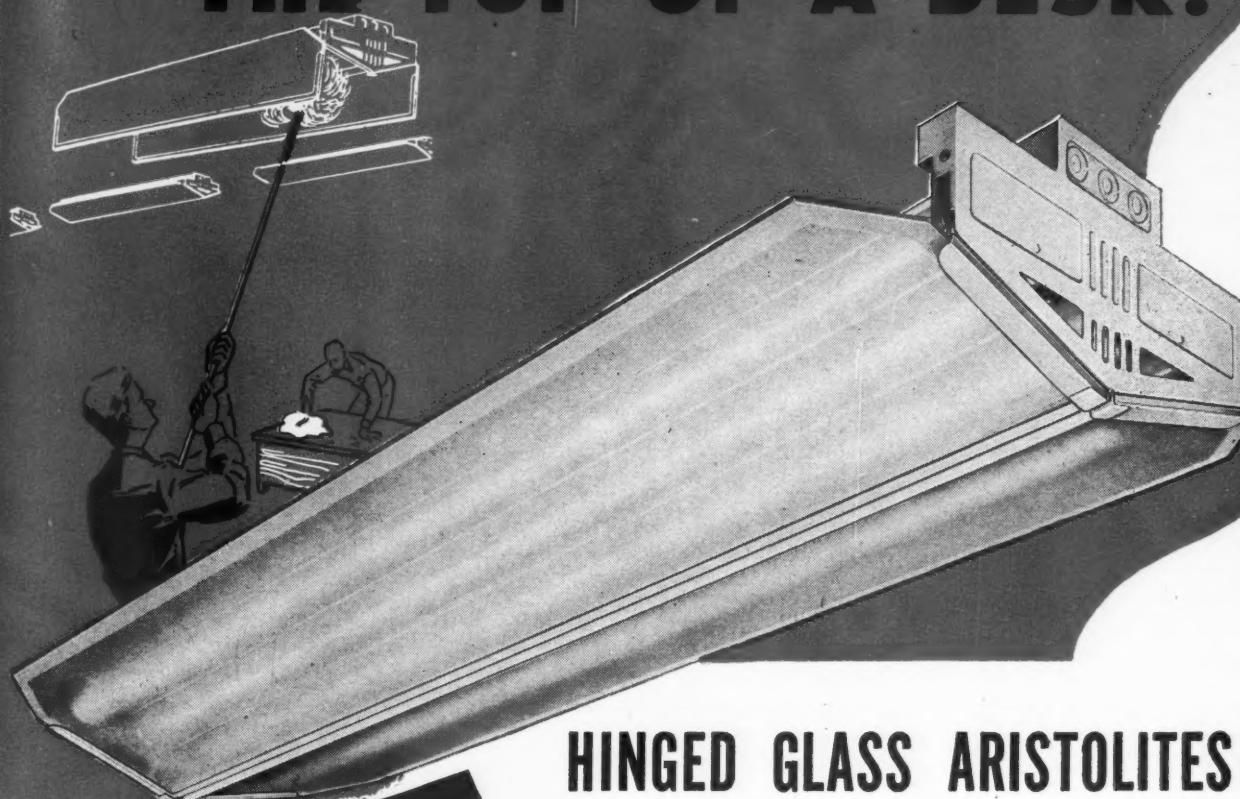


Showing method of mounting lights in a cornice, throwing light both up and down. In this picture the glass in the bottom of the cornice has been removed in all sections except the one at the extreme left.

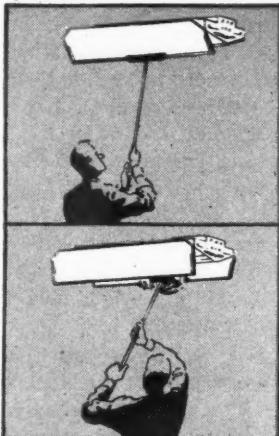


Twin lines of fluorescent lighting above stock shelves are diffused by continuous glass panel. Upward light component illuminates upper walls and ceiling. Wooden cornice shields eyes of customers from direct source brightness.

# AS EASY TO DUST AS THE TOP OF A DESK!



# Guth



## HINGED GLASS ARISTOLITES

The dust and dirt that accumulate on lighting fixtures rob users of much of the illumination they are paying for. Frequent dustings are good business economy.

Now, with GUTH Hinged Glass Aristolites\*, the entire dusting operation can be done regularly...easily...safely...right from the floor! A simple gripper on the end of a pole swings the glass panels free on their GUTH Floating Hinges. Then a duster on the opposite end of the same pole cleans the fixture, and the panels are quickly reseated.

Dusting the Aristolites is just a simple part of the regular weekly routine...as casual as dusting the desks!

## WHY EXPECT PORTERS TO BE ACROBATS!

It's a dangerous, wasteful misuse of manpower for cleaners to scurry up tall ladders, balance awkward glass panels precariously, dust them, juggle them back into position, and then clamber down again. Needless, too, when the whole job can be easily and much more quickly done...right from the floor...with GUTH Hinged Glass Aristolites!

## AT LAST! THE LUMINAIRE THAT MAKES THE DUSTING LADDER OBSOLETE!

Write today for full information about this amazing new Fluorescent Luminaire...the GUTH Hinged Glass Aristolite with the Floating Hinge.

\* Trade Mark Registered—Patent Pending

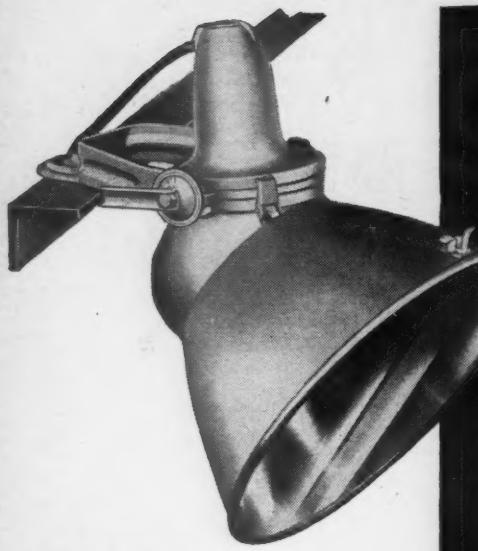
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Type L-69, sports and area floodlight



... and get these  
important advantages

- ★ Proper types and sizes for all applications
- ★ High-efficiency, the result of scientific design
- ★ Long life and low maintenance expense
- ★ Expert assistance with application problems, backed up by 30 years' experience
- ★ Convenient sales and service facilities

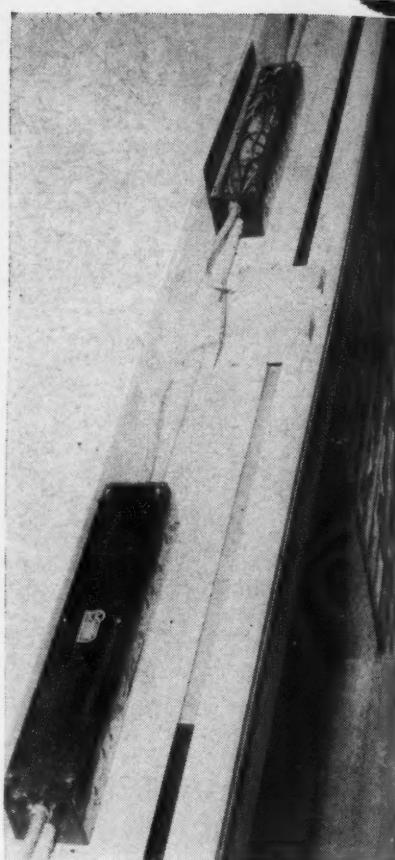
**WANT THESE HANDY DESCRIPTIVE LEAFLETS FOR YOUR PROPOSALS?**

FLOODLIGHT	PUBLICATION	
<b>Heavy-duty, steel casing</b> 200 or 250 watts, Type L-29 300 or 500 watts, Type L-30 750 or 1000 watts, Type L-31	GEA-4303 GEA-4304 GEA-4305	Order individually by number, or in sets, from the G-E Apparatus Sales Office or Agent that serves you. Or write General Electric Company, Schenectady 5, N. Y.
<b>Heavy-duty, cast aluminum</b> 1000/1500 watts, Type L-34 200 or 250 watts, Type L-38	GEA-4517 GEA-4325	
<b>General purpose, sheet aluminum</b> 300 or 500 watts, Type L-49 750 or 1000 watts, Type L-43	GEA-4311 GEA-4310	
<b>Sports and area, sheet aluminum</b> 750 to 1500 watts, Type L-68 750 to 1500 watts, Type L-69	GEA-4333 GEA-4590	
<b>Area, open porcelain enamel</b> 300 to 1500 watts Type L-45 300 to 1500 watts Type L-46	GEA-4433 GEA-4434	
<b>Handy, sheet aluminum</b> 100/150 watts, Type L-65 200 watts, Type L-66	GEA-4516 GEA-4346	
<b>Underwater, cast bronze</b> 100/250/400 watts, Type L-33 500/1000 watts, Type L-39 500/1000/1500 watts, Type L-41	GEA-4438 GEA-4518 GEA-4439	



**GENERAL**  **ELECTRIC**

451-96-3200



**Showing method of mounting ballasts in 4-in. gutter, recessed in false wall —looking downward.**

down and up. What, in effect, had to be provided was a fixture with sockets and tubes only, so designed as to meet code requirements.

The problem was solved by means of a wooden cornice running around the room at the height of the top box tier. This was provided with a frosted glass bottom, permitting light to pass downward to the box ends but concealing the lights themselves from anyone sitting there to be fitted. The top of the cornice is open so that light is thrown up onto the walls, the side of the cornice, however, preventing the lights from being seen from any part of the store.

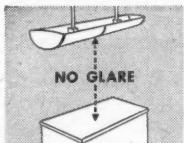
The front of the false wall was recessed, for mounting the ballasts, in a four-in. gutter. A double row of tubes was employed.

The glass panel, beneath the lamps and across the top of the stock shelves, is approximately 7.5 feet above the floor level and 6.5 feet below the 17-foot ceiling. The distance from lamps to ceiling permits greater coverage and greater diffusion so that the ceiling is lighted for a considerable distance out from the wall and harsh shadows are eliminated. The combination of fluorescent and incandescent illumination achieves pleasing tonal balance throughout the store.

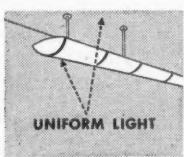
# 6 reasons why the new Wakefield STAR helps you

## "Hang the Sky" FOR Over-ALL Lighting

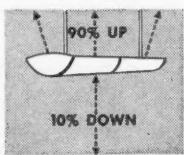
Design Pat. Pend.



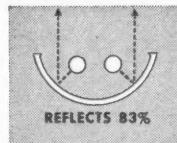
1. Low brightness . . . a maximum of .3 candles per square inch according to ETL test. Means no glare or reflected glare.



2. Blends into ceiling . . . means no distracting dark or bright patterns overhead . . . greater eye comfort.



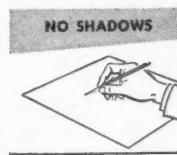
3. Provides soft pleasing indirect light . . . with light distribution 90% UP and 10% DOWN.



4. High efficiency reflecting surface, of Plaskon . . . light weight, non-shattering, non-electrostatic, and reflects 83%.



5. Easy to maintain . . . reflectors slide out like a drawer for quick, easy cleaning, maintenance of original light output.



6. No shadows on work . . . because "ceiling of light" means large area source with light over all . . . and thus . . . Over-ALL Lighting!

# Wakefield

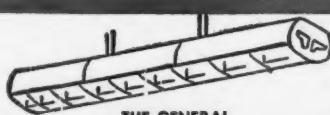
LIGHTING EQUIPMENT FOR OFFICE, SCHOOL AND DRAFTING ROOM

For full details write for Catalog No. 46. The F. W. Wakefield Brass Co., Vermilion, Ohio.



Over-ALL—

in lighting,  
in construction,  
in ease of maintenance.



THE GENERAL



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THE DIPLOMAT

*A*

## MODEST PRODUCT



## *that started Six Factories*

The picture of this Trumbull "Rosette" may draw a chuckle from modern electrical men . . . but like the discovery of the first nugget it showed the way to a streak of pay dirt that has never been exhausted in Trumbull's 48 years of continued progress.

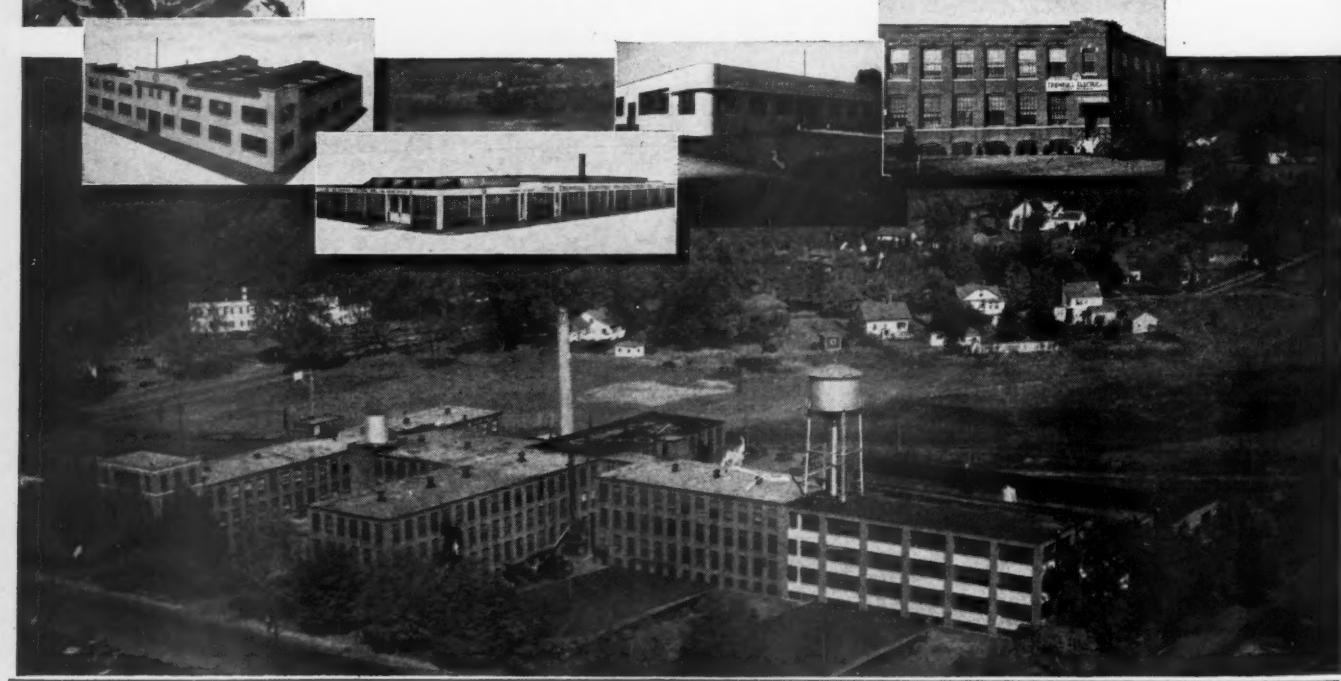
From a modest single product in '99 to a complete line of electrical equipment in '47 . . . with national recognition all the way . . . is the result of an initial determination "to manufacture quality electrical products of first class material and slowly build up a reputation as a house of quality, selling at a fair profit."

A nation wide system of 333 leading electrical wholesalers, backed up by Trumbull sales and service men, brings the Trumbull line to your doorstep. From simple standardized switches to custom engineered switchboards and Busway Systems, Trumbull offers efficient control and distribution of Power and Lighting current for all residential and industrial requirements.



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Pioneer in '99

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# In the News

## Wilke Heads Wisconsin Inspectors

Walter Wilke, Milwaukee, was elected chairman of the Wisconsin Chapter, IAEI at the recent annual meeting of that group in Milwaukee. Chosen as vice chairman is P. E. Widsteen, Menasha; secretary-treasurer John E. Wise, Madison. Serving on the executive committee are: A. Middemas, Milwaukee; Erwin Pagels, Whitefish Bay; P. A. Lundholm, Madison; and A. G. Addler, West Allis.

The 97 registered delegates spent most of the two-day meeting discussing the new National and Wisconsin State Electrical Codes. Regarding the new Wisconsin State Code, published in 1945, J. E. Wise revealed that plans are under way to issue a supplement containing the necessary revisions to incorporate the provisions of the new 1947 National Electrical Code. Through resolution, the Chapter went on record supporting adoption of the 1947 NEC carrying-capacity tables in the State Code; also recommending repeal of the present emergency list of substitute materials and methods. Wise revealed that both Codes recognize the use of aluminum wire for interior wiring as does the Underwriters Laboratories. Special care must be exercised, however, in making connections, he cautioned.

Speaking as a labor representative on the Electrical Committee, E. J. Brown, former president, IBEW, urged cooperation between the electrician and electrical inspector in promoting and permitting the application of new methods and materials once they are proved safe. Emphasizing that materials must be of good grade, he added that common sense should be used in enforcing rules.

The public relations committee of the IAEI is planning a new electrical safety promotional program, according to L. B. McConaghay. Over 2½ million copies of booklets on electrical safety were distributed prior to and during the war, he revealed, adding that a film "Preventing Fires Through Electrical Safety" had been exhibited to about three million persons throughout the country. The latest promotional program will emphasize proper application of approved electrical

cords, he asserted. The hazards of using flexible cords—even though labeled—for circuit extensions; overfusing of circuits; and similar unsafe practices will be emphasized, he concluded.

Fires due to electrical causes are increasing, warned J. E. Kennedy, secretary, the Wisconsin Mutual Insurance Alliance. Some 1400 such fires resulted in a loss of over \$1,500,000 in 1945, he added. Since many of these fires occurred in rural districts where, presumably, wiring was not up to standards, the Farm Mutual Insurance Companies have taken action by sponsoring an electrician's registration and electrical inspection Bill No. 251 now in the Wisconsin State Legislature. Its purpose is to regulate electrical wiring and inspection facilities in rural areas and villages now lacking inspection facilities, he concluded, urging the Chapter to consider and recommend adoption of the legislation. The conference responded by authorizing the executive committee to study and recommend the bill in whole or in part.

E. H. Herzberg, manager, Wisconsin Chapter, National Electrical Contractors Association, reported on another Bill 153S which would permit any county board to adopt an ordinance to establish and maintain an inspection bureau. With certain

amendments removing the limit on inspection cost, his organization has recommended approval, he revealed.

Debate still continues over the State Code rule prohibiting use of flexible cords, plugs and receptacles for connecting lighting fixtures. The Milwaukee Electrical Contractors Association and some inspectors favor the regulation as eliminating the use of improper fixtures and limiting the hazards of improperly supported and ungrounded units. Other inspectors cite the danger of reducing the length of outlet circuit wire pigtails whenever a permanently connected fixture is removed or replaced. No decision was made regarding recommendations for a change in this specific rule.

At the concluding session, the Chapter decided to hold its next annual meeting at Racine, Wis. The date and place is to be announced later.

## Minnesota Law Amended

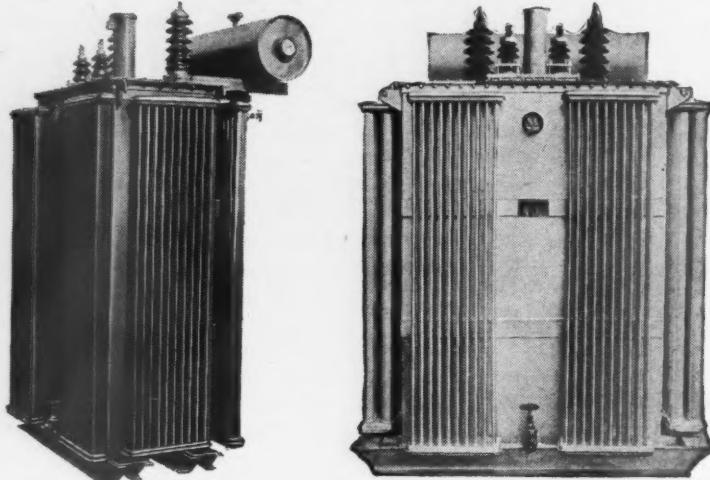
A revised Minnesota Electrical Licensing Law, designed to alleviate the critical shortage of skilled wiremen in the rural areas, became effective in April following unanimous passage by the State Legislature and signature by Governor Youngdahl.



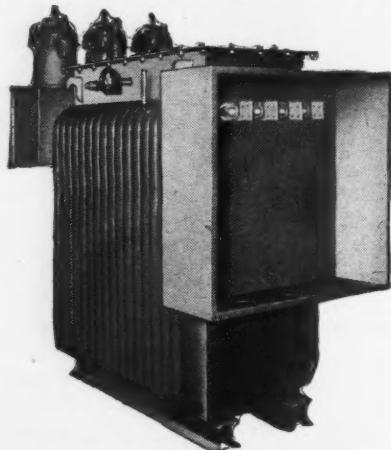
*Two William J. Wheelers, father and son, discuss plans for celebrating the fiftieth anniversary of their elevator and industrial electrical service organization, The Maintenance Company of New York City. Company personnel and friends all took part in the golden anniversary festivities which included a gala party; dinner, dancing and entertainment at the St. George Hotel in Brooklyn on April 18.*

# DAVIS TRANSFORMERS

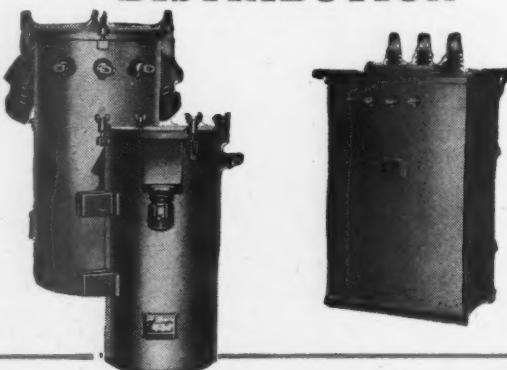
## POWER TRANSFORMERS



## SPECIAL APPLICATIONS



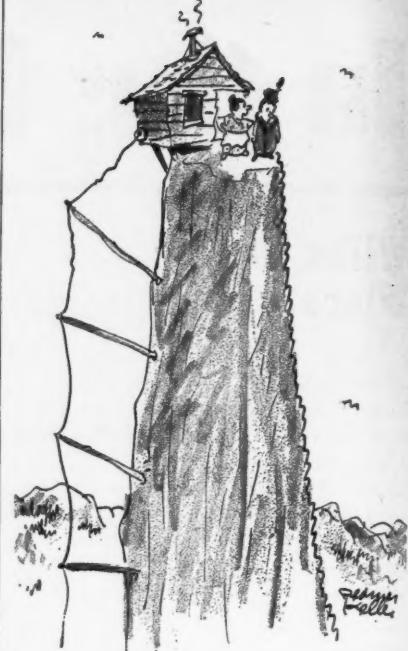
## DISTRIBUTION



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POWER AND DISTRIBUTION TRANSFORMERS



"It was kind of inconvenient at first. For the first fourteen years we didn't even have electricity."

Supported by the Minnesota Electrical Council, Inc., and the Minnesota Electrical Inspectors Association, the revisions comprise amendments to the 1945 Statutes permitting the following:

1. Creation of a temporary Class B Master Electricians classification which terminates on Dec. 31, 1949. To qualify for such a rating, an applicant must have had *at least three years experience* in planning for, laying out, supervising, or installing electrical wiring and equipment for light, heat, or power. An applicant who passes the State Board of Electricity examination (fee \$5.00) and posts the required \$1,000 bond, will be issued a *Class B Master Electrician's License* permitting him to contract for, plan, supervise, or install electrical wiring or equipment *on any farm or in any single or two-family dwelling in any town, village, or city of the third or fourth class, in accordance with regulations governing such work.*
2. Creation of a temporary Class B Journeyman Electrician classification which also terminates on Dec. 31, 1949, to qualify, applicants must have had *at least two years experience* in wiring for, installing and repairing electrical equipment for light, heat or power. Persons successfully passing the State Board of Electricity examination (fee \$3.00) will be issued a Class B Journey-

## SMOOTH REDUCED VOLTAGE STARTING OF SQUIRREL CAGE INDUCTION MOTORS IS ASSURED...

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### "3C" BULLETIN 6080 AC MAGNETIC PRIMARY RESISTOR TYPE STARTERS

- Designed for application on drives requiring reduced torque on starting due to mechanical limitations, or where power restrictions limit the amount of starting current, Bulletin 6080 A. C. Magnetic Starters provide dependable starting performances.

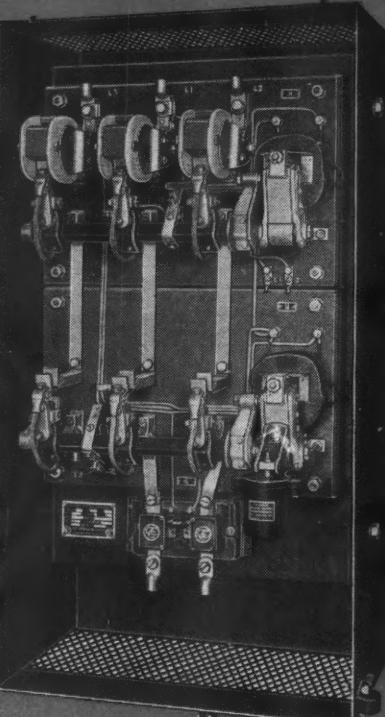
Constantly increasing torque is developed by the motor as it comes up to speed—smooth starts are produced since the motor circuit is not interrupted during the transfer from reduced to full voltage. Bulletin 6080 Primary Resistor type Starters do not reduce the power factor at which power is taken from the line during the starting period.

All sizes of Bulletin 6080 Starters are available in sturdy NEMA Type 1 standard or NEMA Type 5 dust-tight enclosures. Sizes 2, 3 and 4 are for wall mounting; 5, 6 and 7 for floor mounting.

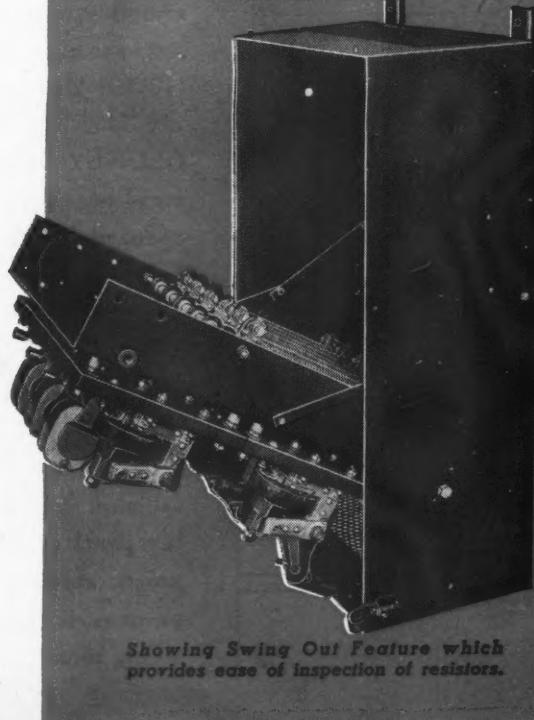
#### FEATURES

- Reduced voltage starting.
- Edgewound accelerating resistors.
- Definite time acceleration.
- Motor overload protection.
- Copper-to-copper contacts.
- Rolling and wiping action on opening and closing keeps contacts clean.
- Arcs quickly extinguished by blowouts.
- Swing out feature for wall mounting sizes.
- Mechanical and electrical interlocks on reversing types.

Ask your Distributor for  
"3C" Bulletin 6080 Starters.



Bulletin 6080 Starter, Size 4  
Front Cover Removed.



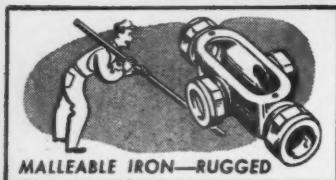
Showing Swing Out Feature which provides ease of inspection of resistors.



THE CLARK CONTROLLER CO.

EVERYTHING UNDER CONTROL • 1146 EAST 152nd STREET, CLEVELAND 10, OHIO

They make  
tough jobs easy  
because  
**GEDNEY**  
**FITTINGS...FIT!**



MALLEABLE IRON—RUGGED



SMOOTH INSIDE AND OUT!



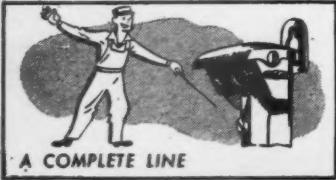
BRIGHT FINISH—RUST PROOF



THREADS CLEAN—EASY TURNING



EASY TO INSTALL



A COMPLETE LINE

**GOOD WIRING DEPENDS  
ON FITTINGS THAT ARE RIGHT  
FOR THE JOB!**

What electricians and contractors want most in the fittings they use is smooth fit. They want conduit to thread in smoothly, caps to fit into place easily, screws to align and tighten evenly. With GEDNEY fittings the contractor knows his job will come out right. All GEDNEY fittings are packed in sturdy, metal-edged boxes that can't break open, and each package is clearly labeled for quick selection.

The fact that GEDNEY fittings have been on the "best seller" list with mechanics who know fine accessories is proof enough of year in—year out excellence. Check the other features in the panel at left. They highlight the points about GEDNEY fittings that mean money in the bank for "live wire" wiring men.

ASK YOUR  
WHOLESALE



WRITE FOR  
LITERATURE

**GEDNEY ELECTRIC CO.**

FOUNDRY, FACTORY & SHIPPING POINT: TERRYVILLE, CONN.  
RKO BLDG., RADIO CITY, NEW YORK 20, N.Y.

man Electrician's License permitting them to wire for, install, and repair electrical wiring and equipment in the areas listed above (less than 20,000 population). Both Class B amendments will expire on Dec. 31, 1949.

3. License fee increases are made in the following classifications: Master electrician—from \$10.00 to \$15.00 annually (renewal same); journeyman electrician from \$1.50 to \$2.00 (renewal same); limited electrician (persons licensed to do special classes of electrical wiring installations and repairs in fourth class towns, villages or cities)—from \$1.00 to \$2.00 with a similar renewal fee.
4. Inspection or reinspection of any electrical installation by a member of the State Board of Electricity upon request of an owner, tenant, utility or contractor. Condemned installations with service disconnected shall not be reconnected until brought up to standards. The State Board fee to cover cost of inspection to be paid by the party requesting it.
5. Electricians licensed by other states may, upon payment of license fee, be granted a Minnesota license of the same grade or class provided these states have a reciprocal arrangement and license qualifications are equivalent to the Minnesota standards.
6. Governing bodies of any political subdivision of the state may by ordinance or resolution provide for inspection of all electrical installations within their jurisdiction. *Inspectors appointed by such groups must have a master or journeyman electrician's license but must not engage in the sale, installation or maintenance of electrical wiring or equipment or appliances nor have any financial interest in any firm engaged in such a business within the jurisdiction.*
7. The State Board of Electricity (which licenses electricians and handles state inspection) is increased from five to *seven* members, the other two appointments by the governor to be representatives of suppliers of electric energy in the rural areas.

Since the State Board of Electricity operates on the fees it collects for licensing and inspection, the increased license fees will permit the expanded operations required by the amended law, and insure a more thorough inspection program in the rural areas.

Most important feature of the amended law, from the standpoint of present conditions, is the creation of



**More foot-candles on the job  
when you install  
ALZAK\* REFLECTORS**

\*Produced by patented process

Alzak\* aluminum reflectors have reflectivity efficiencies as high as 83%. More of the light from the lamps gets off to a good start on its way to where you need light.

And the high-efficiency Alzak surface is durable, easy to keep at peak efficiency by simple cleaning. The reflecting surface cannot chip nor peel. Is unharmed by dents and blows. Never rusts.

Resists corrosion and loss of efficiency in industrial and seashore atmospheres.

You can get Alzak aluminum reflectors in all styles. If the label says "Alzak", you are getting the best lighting surface available. For names of manufacturers of Alzak lighting fixtures, write to ALUMINUM COMPANY OF AMERICA, 1946 Gulf Bldg., Pittsburgh 19, Pa. Sales offices in leading cities.

**MORE people want MORE aluminum for MORE uses than ever**

**ALCOA ALUMINUM**

IN EVERY COMMERCIAL FORM



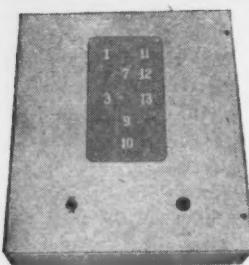
## CHECK THESE CANNON ELECTRIC SPECIALTIES BEFORE YOU BUY

### HOSPITAL SIGNAL SYSTEMS



VISUAL PAGING SYSTEMS

Cannon Electric has built hospital signal systems for more than a quarter of a century — complete from Visual Paging equipment to Aisle Lights. Embodied in Cannon systems are all the desirable features tested and approved in the hospital field.



VISUAL ANNUNCIATOR

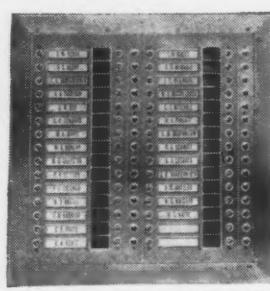
### NURSES' CALL SYSTEMS



TYPE HMW4  
WARD STATION

(Right) Shown is one of the many sizes of In-and-Out Registers made of furniture and steel and duraluminum for long life. Single and double face for 10 to 100 names. Larger units available on special request.

(Left) Shown is one of the 8 basic styles of Nurses' Bedside Calling Stations, available in single, two and three gang types. Foolproof construction and low maintenance cost are leading features.



A THIRTY-NAME REGISTER

### MISCELLANEOUS ITEMS

#### TYPE CCR-1

#### CRIMP TYPE CONDUIT COUPLING



For EMT  $\frac{1}{2}$ " Thick Wall Conduit, Indenter Type. Made of diecast zinc. Shown above, on pipe.



NO BOLT  
TYPE FS-3 — FIXTURE STUD  
WITH LOCKNUT

Zinc,  $\frac{1}{2}$ " pipe thread. Fully tested. Saves mounting time.

#### CONDENSED CATALOG

C-46-A contains all the above fittings, with the exception of the CCR-1 and FS-3, listed in this advertisement together with many other items such as multi-contact plugs and receptacles. For a more complete bulletin on Hospital Signal Systems, ask for Signal Bulletin. Address Department F-231.

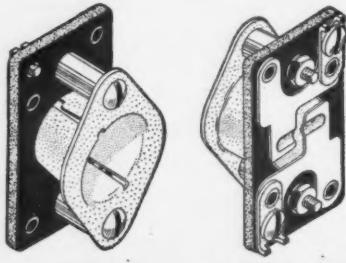


### DIRECT CURRENT SOLENOIDS



Available in 3 diameters in various combinations of voltage pull, armature travel, duty cycle, amperage, and with end bells, if required, similar to type shown above.

### LAMP SOCKETS



(Front) (Rear)  
Shallow mounting lamp sockets for bayonet type (automobile) lamps. Insulator spacers. Single and double-contact types.



## CANNON ELECTRIC DEVELOPMENT COMPANY

3209 Humboldt Street, Los Angeles 31, California

Canada & British Empire — Cannon Electric Co., Ltd., Toronto, Ontario • World Export Agents (excepting British Empire) Frazar & Hansen, 301 Clay St., San Francisco 11, Calif.

the Class B master and journeyman electricians. This emergency move will release, during this critical skilled labor shortage, numerous men who have had sufficient training and experience to install rural and residential wiring but lack sufficient training to become the Class A all-around man necessary to do commercial and industrial work.

That this premise was correct is evidenced by the rush of applicants already under way for the Class B licenses. Indications point to a first Class B examination early in May with other qualified applicants being called in as quickly as the forms can be processed. Farmers and rural home owners will now be assured of competent electricians to install the wiring they so badly need.

## Cannady Reelected

N. E. Cannady of Raleigh, state electrical engineer and inspector, was reelected chairman of the North Carolina chapter of the International Association of Electrical Inspectors at the annual institute for electrical inspectors, contractors and electricians.

C. S. Whitaker, electrical inspector of Durham, was elected secretary-treasurer.

## New Orleans Elects Officers

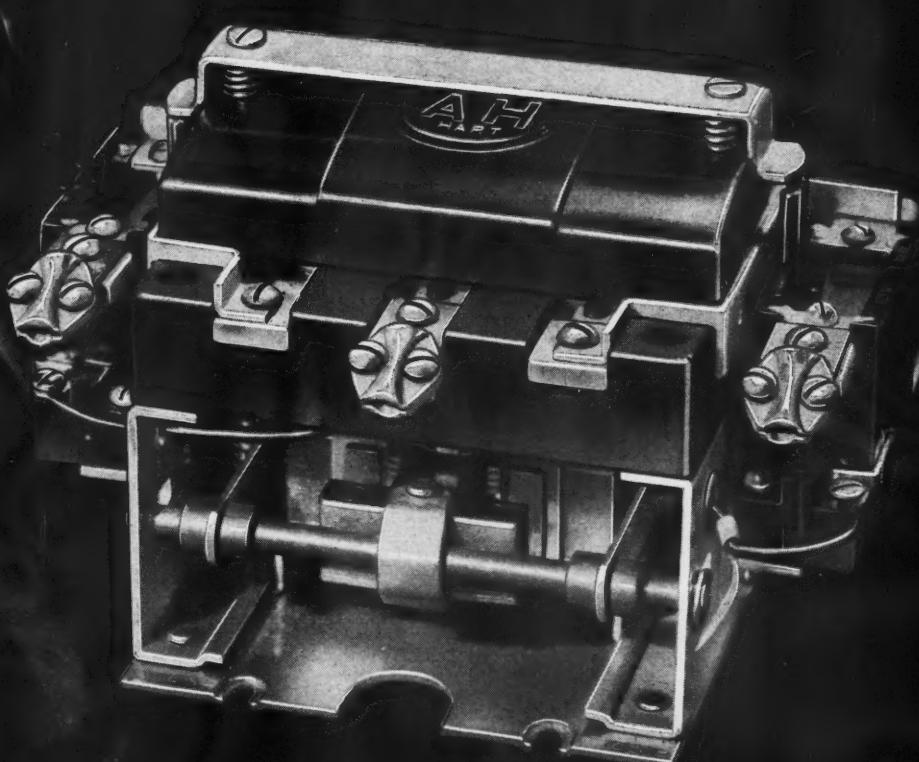
Wayne B. Wands has been elected president of the Electrical Association of New Orleans. Other new officers are S. L. Drumm, executive vice president; Harry B. Lackey, vice-president, wholesalers, utilities and manufacturers; C. C. Walther, vice-president, refrigeration; Walter J. Barnes, vice-president, electrical contractors; J. O. Crary, vice-president, air conditioning and ventilating; A. C. Denny, vice-president, radio; W. E. Clements, director of publicity; J. R. Guidroz, secretary, and I. W. Tufts, treasurer.

## Texas Chapter NECA Elects Officers

The South Texas Chapter of the National Electrical Contractors Association reelected Fred Loth, president; A. C. Loyd, vice president; John Thomson, treasurer; Paul Wright, governor and Frank R. Stewart, secretary-manager. Truman J. Reneberg of San Antonio was named to the board of directors.



# NEW MAGNETIC STARTER



THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U.S.A.



# Tulamp Transformers cut installation costs

## OF MERCURY LIGHTING

Mercury-vapor lighting, with its high efficiency, is the most economical means of obtaining high levels of illumination in many industrial plants. G-E Tulamp transformers provide the most economical method of installing such lighting.

General Electric Tulamp transformers include units especially designed for the popular H-1, 400-watt lamp. All Tulamp transformers combine the ballast of two lamps into one compact unit, reducing by one-half the number of transformers required. Installation is further simplified by carrying a common ground to the lamps. Power factor is 90 to 95 per cent, transformer losses are

reduced, and starting current is less—all of which permits further reduction in wiring costs. Single units cost less than pairs of single-lamp high-power-factor transformers.

Built by the largest manufacturer of Mercury H lamps, Tulamp transformers assure you co-ordinated design of lamp and transformer. They are quiet, eliminate stroboscopic effect, will give years of dependable operation.

**SHORT DELIVERY** G-E mercury-vapor-lamp transformers are available on short delivery. Write for full information on General Electric's complete line of transformers for mercury lighting. Address the nearest G-E office, or Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

**GENERAL ELECTRIC**

## San Diego Electrical Ordinance Passed

San Diego's 20-year-old electrical ordinance has been brought up to date with the passing of a new ordinance to permit the use of any accepted method covered by the National Code. The ordinance, which was passed early in April by San Diego's city council, became effective May 1.

Under the new code, steel conduit is no longer required in new housing. It is still required, however, in all commercial building. Under the ordinance all neon signs must be power factor corrected.

The ordinance was drafted after 18 months of study made by a committee composed of representatives from the electrical industry in San Diego, together with the city electrical inspection department. It is hoped that the new ordinance will pave the way for better and more adequate wiring installations in new homes.

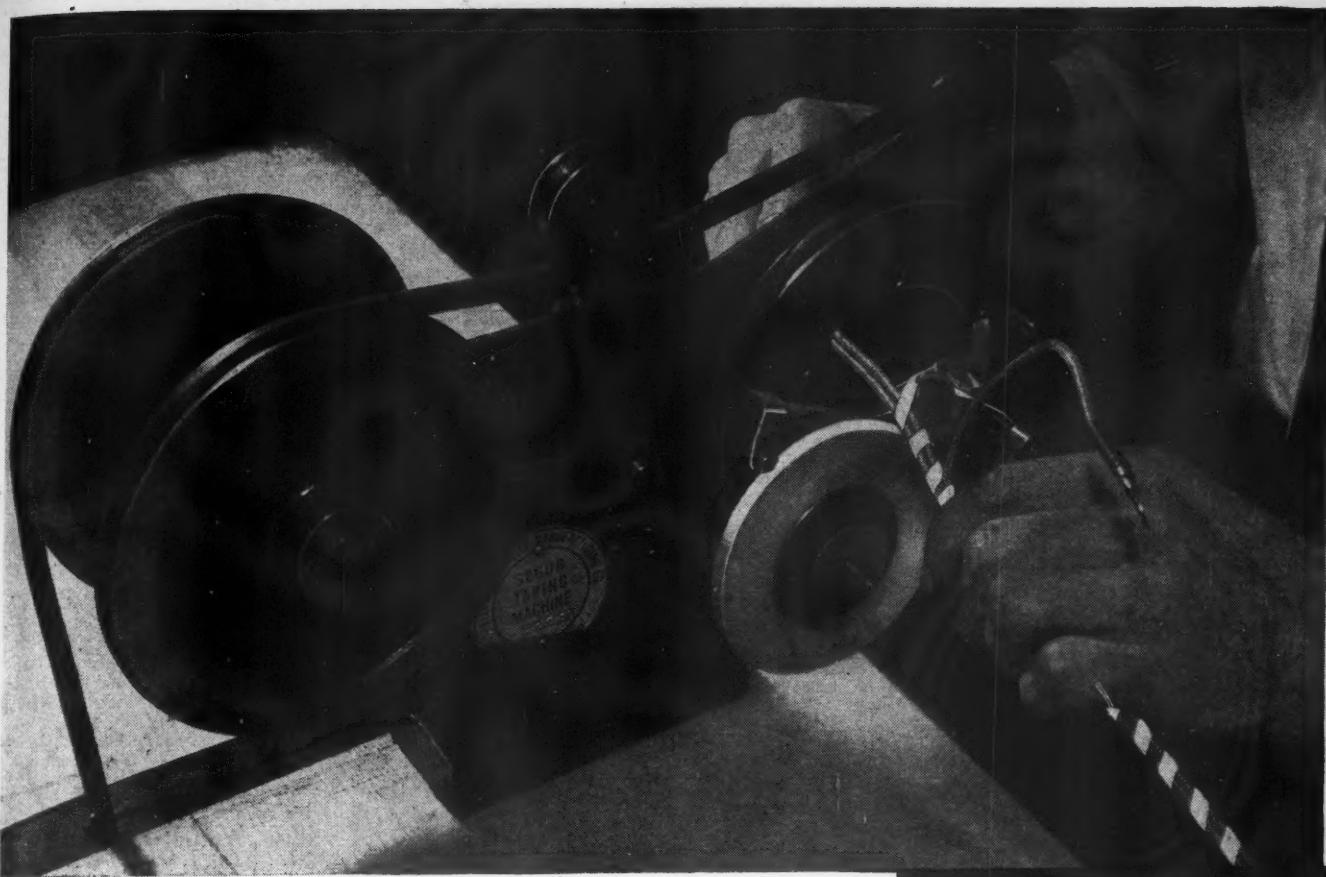
## Safeguards Urged in Electrical Equipment

Proper safeguards in the installation, use and maintenance of electrical equipment were urged as a means of eliminating fire hazards during the recent sessions of the President's Conference on Fire Prevention in Washington, D. C.

These precautions were recommended by a special committee on



Discussing the merits of new aluminum building wires and cables at recent Illinois Chapter, IAEI meeting are (L to R) Don B. Karlskind, mid-western district engineer, wire and cable dept., U. S. Rubber Co., and Leo E. Mayer, manager, contractor sales, Hyland Electric Supply Co., Chicago. Karlskind reported favorable engineer and contractor reaction in plants where new cable has been installed.



## NOBODY CAN AFFORD TO HAND-TIE ELECTRICAL HARNESS ANY MORE

The new high speed way of binding electrical harnesses cuts corners; cuts costs. Instead of tying with string, use a spiral wrap of "SCOTCH" Electrical Tape with Vinyl Plastic backing. Applied with a specially equipped Segur Taping Machine, this remarkable tape does in seconds, work that takes expen-

sive minutes by hand tying. Applied in an open spiral, as in Figure A, "SCOTCH" Vinyl Plastic Back Tape provides a neat, secure, perfectly flexible harness. If a complete protective sheath is desired, the tape can be applied in a tight, overlapping spiral to produce a continuous sheath as in Figure B.

## REG. U. S. PAT. OFF. **SCOTCH** *Electrical* **TAPES** BRAND WITH VINYL PLASTIC BACKING

Make the first move right now toward lower harness binding costs, faster production—write for complete information and a sample of "SCOTCH" Electrical Tape with Vinyl Plastic Backing.

"SCOTCH" is the registered trade-mark for the adhesive tapes  
made in U. S. A. by the

**MINNESOTA MINING & MFG. CO.**

THE 3M COMPANY

SAINT PAUL 6, MINNESOTA



FIG. A



FIG. B

FULLMAN

# Latrobe

PRODUCTS

FLOOR BOXES

WIRING SPECIALTIES



## "Latrobe" Products are easy to install and dependable to use . . .

You can please your customers by recommending "Latrobe" products. You can show how strength and durability can be combined with ease of installation and operation by showing and selling "Latrobe" products.



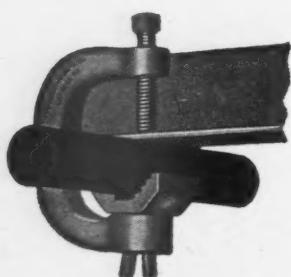
No. 252-R Two Gang Box

This Latrobe two gang adjustable box has No. 208 Receptacle in one section. One cover plate has  $\frac{1}{2}$ " Flush Brass Plug, the other has 2" Brass Plug.



No. 280 Nozzle with  
No. 200 Cover Plate

Ten Amp. 250 Volt Receptacle in Brass Housing mounted on  $\frac{1}{2}$ " brass pipe extension. Longer pipe if desired.



No. 470 "Bull Dog" Pipe  
or Conduit Hanger

A "Bull Dog" won't let go. Hangs  $\frac{1}{2}$ ",  $\frac{3}{4}$ ", and 1" pipe or conduit to beams up to  $\frac{3}{8}$ " thick. Safe, durable, easily installed.



No. 150 Box—  
No. 207 Nozzle

An adjustable, watertight box for use in concrete or wood finished concrete floors. Underwriters approved.



Keystone Fish Wire

Ten different sizes of highest quality flat steel wire—perfectly tempered.



"Bull Dog" BX Cable  
Staples

These strong dependable staples are packed in cartons, kegs and barrels.

FULLMAN MANUFACTURING CO.  
LATROBE . . . PENNSYLVANIA

building construction, operation and protection, which reported that uses of electricity "are so diversified that fires attributed to failure of electrical equipment or to faulty installations have been outstanding for many years in the list of causes." The committee added:

"All electrical equipment should receive the best of maintenance, and due regard should be given to the standards which have been adopted and incorporated in the National Electrical Code. The use of temporary wiring during alterations is a frequent source of trouble and should be reduced to a minimum and replaced with permanent installation as quickly as possible. The improper use of fuses and the overloading of circuits deserve careful attention.

"Electrical equipment should receive frequent inspection by competent persons. It is also important that electric power be controlled by centralized switches which can be opened when power is not in use. The use of warning or pilot lights and thermostatic controls is desirable on all electrically heated devices."

## New Mexico Adopts New Code

The New Mexico Electrical Contractors Licensing Board has adopted a new state electrical code after consultation with representatives of the Associated Electrical Contractors of New Mexico. The new code conforms with the 1947 National Electrical Code.



With a training background secured in both Westinghouse and General Electric shops, F. B. Livingston is shop superintendent of the Jackson-Bayley Electric Company—one of the largest motor repair establishments in Canton, Ohio.

**MAGIC  
IN  
GLASS**

Most of America's bedroom lighting problems can be solved efficiently and in good taste—by selection from this glamorous group of Virden glass bowl fixtures.

Glass is a worthy and flexible medium for the expression of grace and refinement. It can be rich and modest in the same breath.

Functional advantages are good distribution of light; ability to live happily with any decorative scheme; ability to provide modulated color tones including French crystal; crystal; ivory and rose. Ability to remain perpetually new.

See the Virden wholesaler near you.



**John C. Virden Company • Cleveland, Ohio**  
Member American Home Lighting Institute

*Just like picking the*  
**BRASS RING!**  
 Your Luck With Fuses  
 Improves When You

Specify

# MONARCH Renewable FUSES

BUILT WITH AN ADEQUATE  
 AMOUNT OF

**BRASS**

for

**BETTER HEAT  
 DISSIPATION**

Completely Approved

- Complete Line of  
 Knife Blade & Ferrule  
 Types

- Simple to Renew



AVAILABLE THROUGH RECOGNIZED WHOLESALERS  
**MONARCH FUSE CO., LTD.**

118 E. FIRST ST.

JAMESTOWN, N.Y.



William A. Wilson, Gallup, was elected secretary of the board, succeeding Lee Trent, Hot Springs, whose term as board member has expired. F. Carter Womack, Las Cruces, was appointed by Gov. Thomas J. Mabry to succeed Trent as board member. Other members are Elmer Kaemper, Las Vegas; A. B. Purdy, Roswell, and Elmer Zemke, Albuquerque.

## Matthew Luckiesh Awarded I.E.S. Medal

Matthew Luckiesh, D.Sc., D.E., Director of the Lighting Research Laboratory, General Electric Co., has been awarded the I.E.S. Gold Medal, given annually by the Illuminating Engineering Society "for meritorious achievement which has conspicuously furthered the profession, art of knowledge of illuminating engineering." The I.E.S. Gold Medal, highest honor in the field of lighting, will be presented to Dr. Luckiesh, together with an official citation, at the Illuminating Engineering Society National Technical Conference to be held September 15-19 in New Orleans.

Dr. Luckiesh's achievements as a research physicist in the realm of illumination and vision are acknowledged throughout the world. His researches over the past 36 years have resulted in vast new concepts of vision, new techniques of research and instruments of measurement. The establishment of a sound science of seeing, given substance by his findings, has been one of the great advances in the illuminating engineering profession. Similarly distinguished and fundamental has been his work in the technology of radiations below and beyond the visible, particularly in the



**MATTHEW LUCKIESH**

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# GENERAL ELECTRIC Q-FLOOR WIRING ADDS FLEXIBILITY TO STORE LAYOUT

To provide an electrical system that can be quickly adapted to any changes in store arrangement, the new Abraham Drug Store in Burlington, Vermont, has been equipped throughout with Robertson Q-Floors and General Electric Q-Floor wiring.

#### Planned for Efficiency

This attractive four-story building, like larger buildings constructed with Q-Floors, was designed for efficient service and economical maintenance now and throughout its life. Today, Q-Floor wiring provides ample facilities for general and showcase lighting, for cash registers, and other electrical needs. In the future, as layout changes are made, electric outlets can be moved and new outlets added wherever needed — quickly, and without the expense of ripping up floors or installing new raceways.

#### How Q-Floors Save

Any building, large or small, can be designed to stay electrically flexible with G-E Q-Floor wiring. The Q-Floor system — a series of hollow steel cells under the finished floor — provides raceways that can be tapped anywhere in the floor on six-inch centers. Thus, electrical facilities can be changed at any time, with little effort, and at low cost. When building, get Q-Floor planning assistance from your General Electric Merchandise Distributor or a factory underfloor specialist. For information, write to Section C59-618, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut.



All electrical requirements in the up-to-date Abraham Drug Store, Burlington, Vt., are provided for with General Electric Q-Floor wiring. This modern wiring system, making changes in electrical layout simple and inexpensive, will keep this building always electrically young.



Left: Orin Lambert of Sherwin Electric Company, electrical contractors, demonstrates the ease with which new electric outlets can be installed in Q-Floors. Right: L. S. Newton, architect, proudly makes a purchase in the new Abraham Drug Store, which he designed to include General Electric Q-Floor wiring. Note accessibility of electric outlets.



GENERAL  ELECTRIC

**Are You Drilling, Cutting and Chipping Concrete and Masonry the Hard Way?**



**Just try a  
SYNTRON  
ELECTRIC HAMMER**



**and see how quick and easy it can be done  
Save money and time**

*Write for illustrated folder*

**SYNTRON CO., 690 Lexington, Homer City, Pa.**

germicidal and therapeutic wavelength ultraviolet.

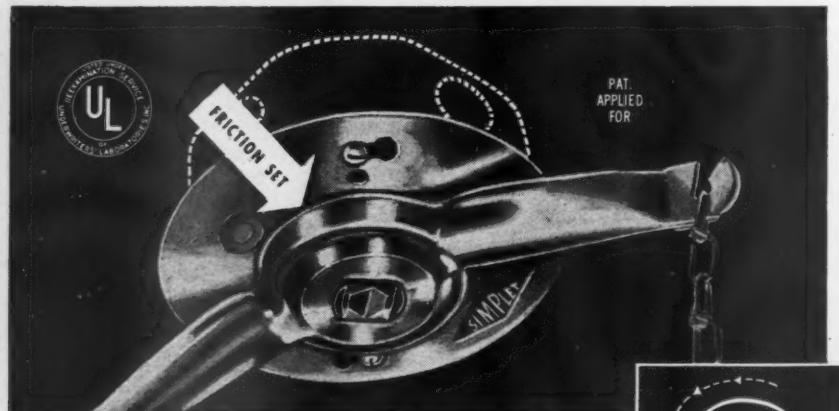
Dr. Luckiesh is a Fellow of I.E.S., and a past-president of the Society (1925-1926). He is a Fellow also of the American Institute of Electrical Engineers, and an active member of the American Association for the Advancement of Science, American Physical Society, Franklin Institute, Optical Society of America, American Academy of Optometry, National Committee for the Prevention of Blindness, and the U. S. National Committee of the International Commission on Illumination.

**Postwar  
Plant Expansion**

The postwar plant expansion boom is passing its peak. Although total plant expansion this year will surpass 1946, it is tapering from the high levels reached at the end of last year.

That's the conclusion of a Commerce Dept. study of projected business expenditures on plant and equipment, released in April.

During the war years, private expenditure on new plant fell off from the 1941 high of more than eight billion dollars, as government spending took over the load. In 1945, however, it began a comeback, reaching \$6,650,000,000. And 1946 saw a fantastic expansion—\$2,200,000,000 worth in the first quarter, \$2,800,000,000 in the second, \$3,310,000,000 in the third,



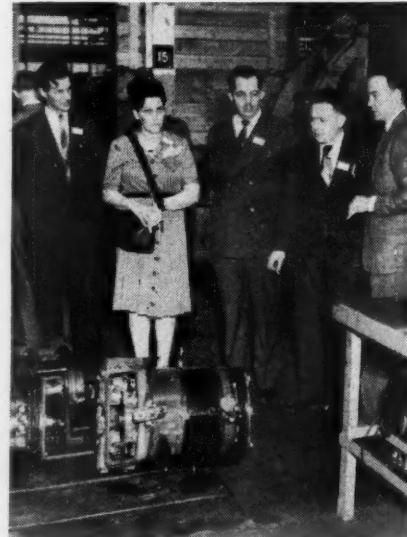
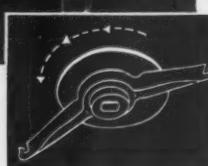
**NEW "Friction-Set"  
FIXTURE HANGER . . .**

*That Adjust With a Twist of the Wrist!*

At last you can get a Fixture Hanger that turns to any angle after being screwed to an outlet box. Although base and receptacle remain stationary, hanger arms may be turned to align with any preconceived lighting plan. Exclusive Friction Ring firmly holds fixture in selected position. Hanger screws on to 3 1/4" or 4" outlet boxes, no other fastening necessary. Furnished complete with receptacle, two 5' chains, hooks and cord clips.

**Friction-Set K100 . . . List Price \$1.10**

*Write for Bulletin K25*



*One of several small groups of NISA members, on a tour of inspection through the Westinghouse Motor Repair shop in South Boston, which was part of the program of the New England Chapter's Foreman meeting held in Boston. Over 125 registrants visited the Westinghouse shop.*



**SIMPLET ELECTRIC COMPANY**

3600 West Potomac Avenue • Chicago 51, Ill.  
112 Charlton Street • New York 14, N.Y.

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**MAKE SAFE HOUSE SERVICE  
CONNECTIONS WITH**

# ILLINOIS

**time-proven quality**

## PORCELAIN WIREHOLDER INSULATORS

Made in sufficient styles and sizes to meet all requirements, these dry process wireholders have rounded corners to prevent injury to the wire insulation. The all-steel screws are hot galvanized by a process that gives them a smooth, even coating. They have deep, sharp threads for easy installation, are fastened into the insulators with non-shrinking metal alloy. No rust streaks on the sides of buildings will occur. Wet process porcelain supplied on special order.



## ILLINOIS WET PROCESS GUY STRAIN

### INSULATORS . . .



**deadends the service lines against the house in the case of heavy lines**

Only materials that meet our high specifications are used so that we can assure top quality wetprocess guy strain insulators. Plant control guarantees the proper handling of the material — careful firing makes possible an insulator without internal stress. Large stocks of standard sizes are carried.



### KNOBS

Cement coated — extra length nail—genuine leather washer—code standard. They don't chip when driven in and they do stay in place and have a firm grip. Available in a wide variety of heights, diameters, holes, and grooves.



### STANDARD TUBES

In sizes  $1/2$  to 48 inches long,  $5/16$  to 3 inches diameter in following types: unglazed, glazed, split, floor, split floor, headless, curved and, crossover split, and cross over. Diameters all uniform both inside and outside.

**ILLINOIS ELECTRIC PORCELAIN CO., Macomb, Illinois**

# RELIANCE AUTOMATIC TIME SWITCHES



## Model "W"

Completely automatic . . . extremely simple, compact, economical . . . three types cover practically every requirement . . .

### ASTRONOMIC TIME SWITCH

The Model "W" Astronomic types are particularly popular for advertising illumination. The "on" operation changes daily to correspond with local sunset time, eliminating the necessity of resetting the dial as the days become longer or shorter.

## AMERICA'S RELIABLE 24 hour-a-day GUARDIANS

RELIANCE Time Switches have proved their dependability. They give complete and reliable service under many varied conditions—a factor of paramount importance when constant good service is essential. Send for catalog and price sheets for complete details.

**RELIANCE AUTOMATIC LIGHTING CO.**  
1907 MEAD STREET RACINE, WISCONSIN



Selecting a session on the full program of the recent North Central Electrical Industries convention at Duluth are: (L to R) R. D. Anderson, Parsons Electric Service, Minneapolis; Otto Woodward, president, and J. Kenneth Harrington, Sales manager, Terminal Electric Corp., Minneapolis; and Edward Hoffmann, president, Hoffman Electric Construction Co., St. Paul.

and \$3,730,000,000 in the fourth quarter.

That was the top. The first quarter of this year showed a slump to \$3,440,000,000. Plans of business firms reported to SEC and Commerce indicate a slight recovery to \$3,560,000,000 in the second quarter. Expenditures in the second half of the year, however, are expected to be well below the second half of 1946, and will total about \$6,890,000,000.

The major drop is in the manufacturing industries. Plant and equipment expenditures of these industries were \$1,650,000,000 in the third quarter and \$1,760,000,000 in the fourth quarter of 1946 but are dropping to \$1,620,000,000 in the first quarter of this year, \$1,530,000,000 in the second quarter; and the second half of the year will total \$3,020,000,000—about 11% lower than the same period in 1946.

Expenditures of mining firms reached their peak the first quarter of 1947 and are leveling off at a slightly lower level for the rest of the year. Railroad plant and equipment is just reaching its peak this quarter and is due to fall off in the second half. Commercial and miscellaneous is also peaking off in the second quarter.

Only electric and gas utilities are still on the upgrade. Plant and equipment expenditures of this industry, which rose from \$180,000,000 a quarter to \$360,000,000 during 1946, will hit a \$460,000,000 quarterly rate in the second half of 1947.

There's no agreement on reasons for the turndown. Some private surveys indicate that present high prices of



**PICK UP  
COMMUTATORS  
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Nearest You—**

Boston - Chicago - Cincinnati - Cleveland - Los Angeles  
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**3 FACTORIES**  
to serve you  
**TOLEDO · HOMER · HILLSDALE**

# VENTILATION PROSPECTS

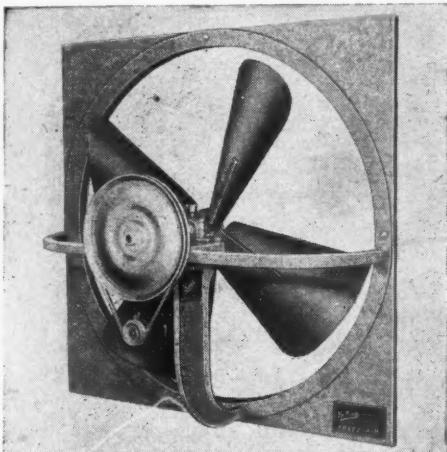
By The Hundreds

IN YOUR TERRITORY

## NEED "Buffalo" FANS!

Homes, plants, restaurants, shops—right in your territory—will need the low-cost, trouble-free cooling of "Buffalo" Fans during the stifling hot months. "Buffalo" Fans are easy to sell, easy to install, easy to service. Each is built to handle its rated job to perfection—

rigidly tested to meet specifications—husky, quiet running, high in efficiency. There are "ventilation profits" waiting for you—and you're safe in dealing with "Buffalo," makers of better fans for over half a century!



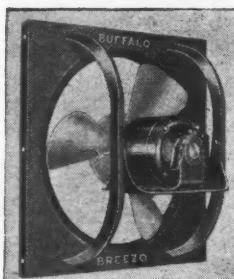
"Belt-Air" Fans

These fans withdraw enormous quantities of stale air quietly, at trifling cost. For shop ventilation, specify the BELT-AIR model, in 5 sizes up to 19,000 cfm capacities. For attic cooling, use the Breez-Air, a fan developed specially for this service, similar in appearance to the Belt-Air.

For continuous service, commercial and industrial ventilation, install square panel Type "NV" HEAVY DUTY BREEZO FANS. Sizes 24" and larger. Full information on request.

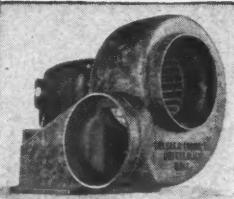
### BREEZO FANS

Breezo Fans have die-shaped steel blades, balanced to assure smooth running, heavy duty motors. All steel construction of panel arms and bracket. Complete range of sizes from 8- to 24-inch. Ideal for continuous operation handling gases, fumes or vapors, or for ordinary ventilating service.



### BABY VENT SETS

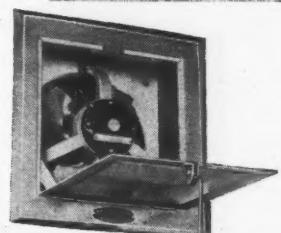
A universal portable fan for ventilation in hard-to-reach places and for exhausting gas, smoke, odors, steam, etc., from hooded vats, toilets, telephone booths, industrial process rooms. Compact, high-delivery fans, in a complete range of capacities.



### 8" KITCHEN VENTILATING FAN

Self-lubricated, sealed-for-life General Electric motors. Double door arrangement guarantees draft free installation. Easy to keep clean. No hard-to-clean, bothersome-to-remove, grease-catching grillework on inside door.

*Don't delay! Find out now about our liberal dealer and distributor terms—Write or wire:*



**BUFFALO FORGE COMPANY**  
520 Broadway  
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Buffalo, N. Y.

"Buffalo"

VENTILATION  
FANS



**M**ILLIONS of dollars' worth of top-quality electrical equipment are now being offered by your Government at a fraction of their cost. Most materials are *unused* and afford a real money-saving opportunity for alert users, commercial buyers and exporters. Inventories of various types of equipment are held by all War Assets Administration Regional Offices. Some items are now being sold on a fixed price basis while others will be offered on competitive sealed bid sales. Visit your Customer Service Center or write the Regional Office holding the inventories to place your name on the mailing list for this type equipment.

**EXPORTERS!** Your business is solicited. Much material which is surplus in the United States is urgently needed or is readily salable in other countries. Watch for our offerings; many of them may be of interest to your clients.

# On Surplus

**LIGHTING PANEL BOARDS—DISTRIBUTION PANEL BOARDS.** There are wall and column types—both large and small capacity. Some have interlocked doors for added safety. In many cases, their construction permits alteration without disturbing wiring connections. This equipment will be offered on sealed bid basis. Largest inventories are held by: Boston, New York, Cincinnati, San Francisco, Seattle, Birmingham, Spokane, Los Angeles and Portland. Other regions have smaller stocks.

\* \* \*

**FLOOR BOXES AND COVERS—SCREWED CONDUIT FITTINGS—JUNCTION, SWITCH AND OUTLET BOXES AND BOX COVERS.** Some standard, some explosion-proof, *all* of these units are of high quality and proved dependability. There are many types and sizes available to meet your needs. Some items are being sold on a fixed price basis, others on competitive sealed bid. Large inventories are held by the following Regional Offices: Boston, Chicago, Little Rock, Los Angeles, New York, San Francisco, Seattle and Spokane. Other regions have smaller stocks.

\* \* \*

**CIRCUIT BREAKERS—OIL CIRCUIT BREAKERS—AIRBREAK SWITCHES—SWITCHBOARDS—ASSORTED ELECTRICAL SWITCHGEAR.** Both oil and air types of circuit breakers are offered in this great sale. Many types and sizes of panels and electrical switchgear are available and *all* are of high quality. This equipment will be offered on both Fixed Price and Sealed Bid Sales. Regions holding largest inventories: New York, Philadelphia, Denver, Chicago, Richmond, Atlanta and Detroit. Other regions have smaller quantities.

OFFICE OF GENERAL DISPOSAL

★ WAR ASSETS ADMINISTRATION

Offices located at: Atlanta • Birmingham • Boston • Charlotte • Chicago  
Cincinnati • Cleveland • Denver • Detroit • Grand Prairie, Tex. • Helena  
Houston • Jacksonville • Kansas City, Mo. • Los Angeles • Louisville • Minneapolis  
Nashville • New Orleans • New York • Omaha • Philadelphia • Portland, Ore. • Richmond  
St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane • Tulsa



1153

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JUNE, 1947

157

# PARTS FOR FANS MOTORS CONTROLS

PROMPT SHIPMENT FROM LARGE STOCK  
AUTHORIZED PARTS DISTRIBUTOR

Brown-Brock-  
meyer  
Century  
Cutler-Hammer  
Delco  
Diehl  
Duro  
Emerson

General Electric  
Hamilton-Beach  
Holtzer-Cabot  
Howell  
Hunter  
Ilg  
Leland  
Marathon

Master  
Peerless  
Robbins & Myers  
Star  
Thor  
Wagner  
Westinghouse

**READING ELECTRIC COMPANY, INC.**

Parts Distributors for the Manufacturer

200 William St.      Barclay 7-6616      New York 8, N. Y.



James C. Devlin, owner of the Devlin Electric Construction Company, Pittsburgh, believes that electrical contractors in the Pittsburgh area have an opportunity for service unsurpassed in any other section of the country. Due to geographical location, physical topography and natural resources, the area has one of the greatest concentrations of industrial and commercial activity and wealth to be found. Electrical distribution, installations and maintenance are the sustaining necessities for the business life of the area.

construction and machinery are a major deterrent. Dept. of Commerce information, however, is quite contrary. The department was so disturbed by the results of its survey that it ran a supplementary check, interviewing some thirty of the larger firms whose expenditures were trending down.

The department's conclusion is that price and labor problems are not a factor. The downturn reflects completion of planned re-conversion programs. Firms interviewed felt they had reached a point where their production capacity was in balance with their expected markets. Interestingly, this conclusion did not rest on any scaling down of expected markets. Presumably serious indications of a slackening market for industrial products could result in a downward readjustment of capital expansion plans.



**BREAD and BUTTER**... the staff of life  
... SUPER-STIK the splice of life. Ask only authorized  
electrical wholesalers for SUPER-STIK.

**Super-stik**  
FRICTION TAPE  
"Sticks to the End"

SUPERIOR INSULATING TAPE COMPANY  
ST. LOUIS, MO. U. S. A.  
Established 1923

## Code School For Contractors On Coast

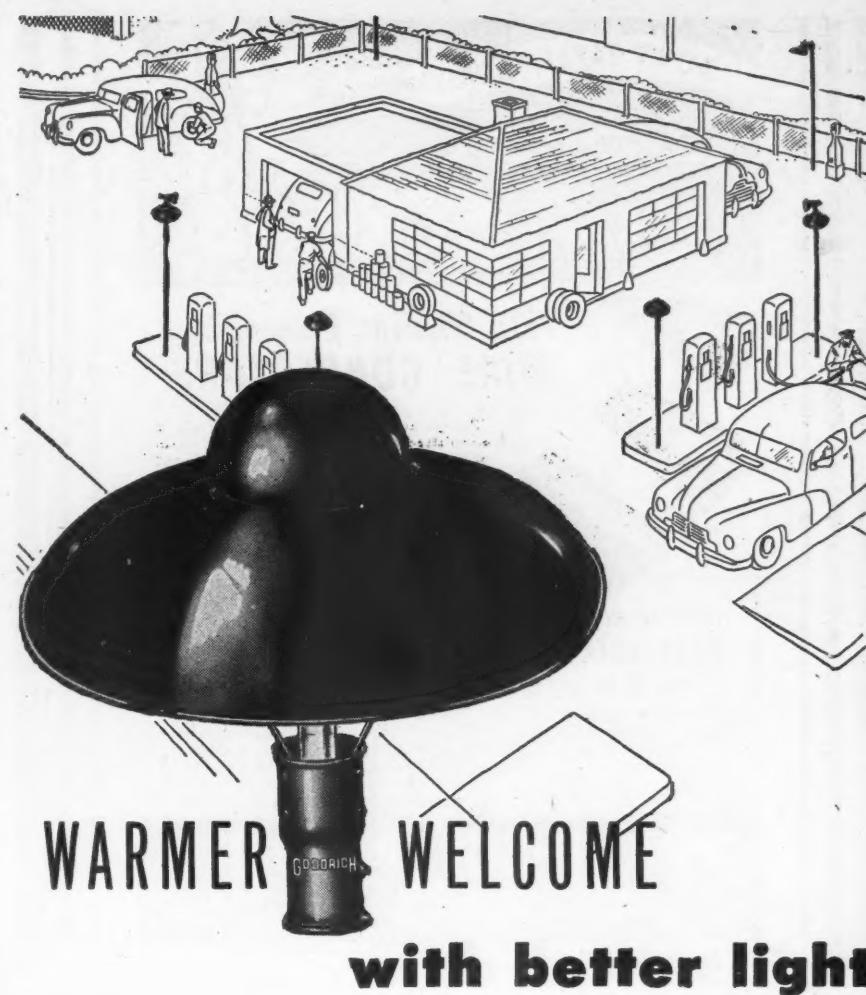
When 1300 electricians and contractors regularly attend an evening course on the National Electrical Code it rates the word extraordinary. Such is the largest class in the history of the San Francisco unified school district, trade and industrial education division, which is conducting the course at Mission adult school, San Francisco, at the request of I.B.E.W. Local No. 6, and the San Francisco

Electrical Contractors Assn., Inc. Organization of the material and facilities is under Joseph E. Clisham, coordinator for the district, and the instructor is Harold L. Gerber, former chief inspector, San Francisco Dept. of Electricity, and now a consulting engineer with A. A. Coddington & Co. The class outgrew the auditorium at Horace Mann School where it started with 750 and increased in size at each successive session. Now in its second month, with regular Tuesday evening meetings, the course has an attendance averaging over 1300 at each session.

The course was instituted because electrical contractors complained that efficiency of wiremen was poor due to ignorance of the Code and of wiring methods. Charles Foehn, business manager of Local No. 6, and William Varley, manager of the contractors association, having had experience with the San Francisco school department in the apprenticeship program, presented the problem to the San Francisco Board of Education. Gerber was selected as the best qualified man to teach a course on the Code because of his experience in the department of electricity. Likewise, he correlates the 1947 edition of the Code with the city department rules and the California State Safety Orders.



Edward Gudum, vice-president of Harlan Electric Co., enterprising electrical contracting firm of Detroit is a proponent of visual education. He plans to take movies of unique and difficult installation techniques and show them to other mechanics employed by the company.



"Howdy, friend!"

That's how the well-lighted place of business welcomes customers—beckons to passers-by.

No one knows better the importance of good illumination than the gasoline service station operator. And that's why you'll find Goodrich equipment in thousands and thousands of service stations everywhere.

Behind its popularity are good reasons—high illuminating efficiency and modern, distinctive appearance. Standlites bring light closer to the ground, diffuse it over a wide area, minimize glare. And Goodrich floodlights add the final touch that bespeaks alert and friendly service.

Finish is high-fired porcelain enamel, entirely weatherproof; made to last a lifetime. Write us for the facts.

Sold Through Electrical Wholesalers



Elipso Angle Standlite directs light forward and laterally in a long, narrow pattern.



Combination Standlite includes a floodlight for lighting buildings.





## Fast, Efficient, Economical WIRE CONNECTORS

"Roughing in" of permanent wiring is simplified with SCRU-ITS. They form efficient and safe connections without using tape, solder or tools. Better mechanical contact—no shorts or grounding. Compact in size.

EASY TO USE . . .  
 1. STRIP WIRE ENDS  
 2. SCREW IT  
 3. THAT'S IT—WITH SCRU-ITS!

Four sizes for joining many combinations of AWG solid and/or stranded wires.

### 101 USES . . . Here Are a Few!

- Fixtures
- Outlet Boxes
- Fuse Boxes
- Panel Boards
- Switch Boxes
- Lighting Devices
- Conduit Boxes
- Circuit Breakers
- Switch Controls
- Motor Connections

Underwriters Laboratories Inc. Approved

### WRITE TODAY FOR DATA SHEET

No. U-6a

It contains complete specifications on SCRU-ITS sizes, dimensions, uses, etc.

### SOLAR ELECTRIC CORPORATION

FACTORY and SALES OFFICES

WARREN, PENNSYLVANIA



Edwin Melander (left), Melander Electric Co., Chicago City, Minn., tells W. Ray Arnold, Casselton Electric Co., Casselton, North Dakota of some 60 farm wiring jobs he had to pass up because of shortage of skilled help. Lamenting took place during recent North Central Electrical Industries convention at Duluth.

## Refrigeration Men Band in Northwest

The Refrigeration Contractors Association of Washington State has been formed by the Refrigeration Contractors Association of Seattle and the Inland Empire Association of Spokane, with headquarters established in Seattle.

James Lessard of the Automatic Refrigeration Co., Seattle, is president, with S. F. Thomas of the W. E. Stone Co., Seattle, Secretary-Treasurer. Directors are C. L. Quinn, Puget Sound Refrigeration Co., Seattle; F. L. Van Winkle, Tacoma Refrigeration Co., Tacoma; Fred Cheatham, Cheatham & Carter, Olympia; William Vogel, Coastal Refrigeration, Chehalis; John Lavender, Lavender Refrigeration Co., Wenatchee; Clifford Ruxton, Ruxton's, Inc., Yakima; K. G. Bentley, Bentley's, Walla Walla; Tom Morrison, Empire Electric Co., Pasco, and Ed Matthew, Electro-Kold Refrigeration, Spokane.

## A.C. OR D.C. POWER

PORTABLE,  
STANDBY OR  
STATIONARY

You can simplify any power-for-electronics problem with an ONAN Electric Plant. A wide range of models and sizes makes it easy to choose the right plant for the particular application. Lightweight models one or two-cylinder air-cooled models for easy portability—A.C. 350 to 5,000 watts, D.C. 600 to 5,000 watts. Onan two, four and six-cylinder water-cooled models are built for continuous heavy-duty operation, stationary or mobile. A.C.—3,000 to 35,000 watts, D.C.—3,500 to 10,000 watts. ONAN Electric Plants: A.C.—350 to 35,000 watts in standard voltages and frequencies. D.C.—600 to 10,000 watts, 115 and 230 volts. Battery chargers—500 to 6,000 watts, 6 to 115 volts.

D. W. ONAN & SONS INC.  
2128 Royalston Ave. Minneapolis 5, Minn.

For—  
 Radio Station Standby  
 Geophysical Survey  
 Railroad Radio  
 "Spot" Recording  
 Mobile Radio Units  
 Municipal Signal Standby  
 Amateur Radio  
 Write for Folder!



## ONAN ELECTRIC PLANTS

## NEWA Meets in Atlantic City

The industry-wide challenge to more effective selling and greater service inherent in its dramatically presented theme of "The Coming Electrical Age" was stressed throughout the 38th Annual Convention of the National Electrical Wholesalers Association held May 4-8 at the Hotel Traymore,

Atlantic City, with a record registration of 1700.

E. B. Ingraham, president, Times Appliance Co., Inc., New York, was elected president of N.E.W.A., succeeding John L. Busey, president, General Electric Supply Corp., Bridgeport, Conn. George F. Kindley, vice president, Edgar Morris Sales Co., Washington, D. C., was elected chairman of the Association's Appliance Division, succeeding Mr. Ingraham. Mr. Kindley and D. M. Salsbury, executive vice president, Westinghouse Electric Supply Co., New York, who was re-elected as chairman of the Apparatus and Supply Division, also became vice presidents of N.E.W.A.

In his opening address Mr. Busey warned that electrical wholesalers must learn once again how to sell. He viewed the present economic situation as highly confused and placed special emphasis on the need for a logical reduction of inventories and careful control to keep them safely in line with requirements.

The importance of people as "ultimate markets" for all electrical products was described by George E. Whitwell, vice president, Philadelphia Electric Co., in his address on "Your Opportunity in the Coming Electrical Age" which opened the sessions sponsored by the Appliance Division. He quoted statistics evidencing the fact that the overwhelming majority of America's 142 million people have had no previous adult experience with a free market for appliances, or with a peace-time economy or the 1929 crisis.

Characterizing electrical appliance advertising as still being in the "nut and bolt stage," Mr. Whitwell said that there is glamour in our business but we usually miss the boat. . . . "We point to the glistening porcelain when we could much more pointedly refer to the housewife's glistening complexion—a result in some measure at least of the benefits of greater convenience and more leisure obtained through the use of work-saving household electrical appliances."

Mr. Whitwell, speaking of inflation and the present unbalance in price, urged that price reduction start with greater productivity per man-hour. That, plus competition, he predicted, could give us a solution to our national economic problem, . . . "unless we monkey too much with the machinery." He foresaw the possibility of a slight recession the latter part of this year and part of next, followed by four or five years of good business, adding that "we must subordinate our greed and selfishness."

In his introduction of the motion picture, "Singing Wires," sponsored by *Farm Journal*, Frank Watts, ex-



GREENLEE HYDRAULIC BENDER

Timesavings of 50% to 60% through the use of a GREENLEE Bender on conduit installations are reported by E. F. Holland, owner of Ace Electrical Co., Miami, Florida.

"Where unusual construction of a building calls for various types of conduit bends—right angles and offsets—you can make them easily with a GREENLEE and get better appearance on the job", says Mr. Holland.

Let a GREENLEE Bender make important timesavings for you, too, and eliminate the cost of many fittings,

manufactured bends and their cost for threading and fitting. The GREENLEE is one-man-operated . . . in but a few minutes produces smooth, accurate bends in pipe up to 4½", rigid and thin-wall conduit, tubing, bus-bars. Easy to set up and operate."

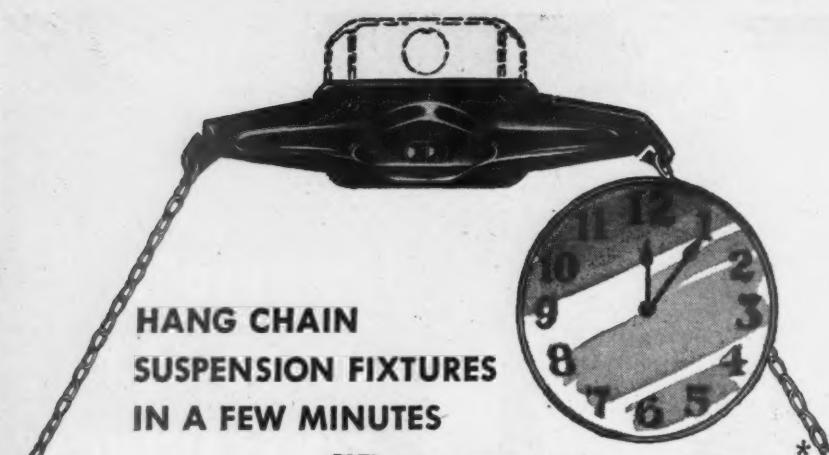
For complete data on GREENLEE Hydraulic and Hand Benders to speed your jobs, write Greenlee Tool Co., Division of Greenlee Bros. & Co., 1746 Columbia Avenue, Rockford, Illinois.



TOOLS FOR CRAFTSMEN

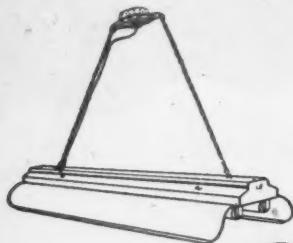
**GREENLEE**

OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK  
Hand Benders • Joist Borers • Cable Pullers • Radio Chassis Punches • Pipe Pushers



HANG CHAIN  
SUSPENSION FIXTURES  
IN A FEW MINUTES

## WITH HYDEE HANGER\*



\*Patent No. D-141024,  
others pending.  
Underwriters approved

Just connect wires—screw to outlet box. No centering, punching, drilling. No tools except a screwdriver.

Complete with receptacle, two 5-foot chains, "S" hooks and cord clips. Self-grounding—you can use 2-wire cord and plug. Fits standard 4" or 3 1/4" outlet box or \$1.65 each list

Day-Brite Lighting, Inc., 5402 Bulwer Ave., St. Louis 7, Mo. Nationally distributed through leading electrical supply houses.

In Canada: address all inquiries to Amalgamated Electric Corp., Ltd., Toronto 6, Ontario.

IT'S EASY TO SEE WHEN IT'S

**DAY-BRITE**  
Lighting



## IN THE SPOTLIGHT



**No. 63310**

Install this socket where toughest conditions prevail. You will then be convinced that you should standardize on the 63310.

TOUGH  
CANVAS IMPREGNATED  
BAKELITE  
WEATHERPROOF  
LONGER LIFE  
LESS REPLACEMENTS

Ask Your Jobber

**UNION INSULATING CO., INC.**  
PARKERSBURG, W. VA.

ecutive assistant of that publication, declared that the farm market is the greatest single new market our industry ever had—one equalling \$500,000,000 in annual sales. "Electricity is the greatest force in farm life," he said. "The prosperity of the farmer is essential to the prosperity of the United States. Greater use of electricity will enable the farmer to increase his efficiency and offset, at least in large measure, the losses resulting from lower prices and a decline in the market demand for farm products."

During the meetings sponsored by the Apparatus and Supply Division, R. Stafford Edwards, president of NEMA, who spoke on the "Go All-Electric" theme, placed great emphasis on the necessity for all segments of the electrical industry viewing their problems as "total industry problems rather than as the individual problems of the utility, manufacturer, wholesaler or contractor."

"The adequate wiring program alone," he said, "speaks in terms of 4,000,000 new homes that must come within five years, and another 2,300,000 homes where the occupants want electrical modernization. We are talking of 235,000,000 simple items such as boxes, receptacles, switches, fuses and circuit breakers. We are talking of 800,000 more costly items in service equipment, and wire for 20,000,000 branch circuits. We are talking of 10,210,000 units such as refrigerators, dishwashers, ranges, water heaters, controls and other appliances. We are talking of \$48,000,000 worth of electrical equipment necessary for generation, transmission, distribution and sub-stations."

"Lighting America at Home and at Work" was the subject of a dramatized presentation arranged by the General Electric Company Lamp Dept., Nela Park, and introduced by W. H. Robinson, Jr., advertising department manager, assisted by H. H. Green. Through the use of colored slides and large placards, the recently announced Planned Lighting Program, sponsored by E.E.I., was interpreted in terms of business development possibilities for the electrical retailer, wholesaler and contractor.

"We can promote electrical appliances and all our other products and we can talk about adequate wiring until we are blue in the face, but until that situation (the bottleneck of inadequate wiring) is brought forcefully to the attention of potential buyers, and to every architect, engineer, builder and contractor, we will still be in the infant stages of the 'Coming Electrical Age'." This viewpoint was expressed

by A. Carl Bredahl, manager and technical director, Better Homes, Westinghouse Electric Corp., Pittsburgh, in his brief talk prior to the showing of the technicolor motion picture, "Dawn of Better Living."

## Southwestern Region IES Holds Conference

The Southwestern Region, Illuminating Engineering Society, held a two day session recently in San Antonio, Texas at the Plaza Hotel. The variety and excellence of the program, plus a record attendance of 184 members and guests, contributed to the outstanding success of this meeting.

An all-day lighting sales conference was held on the opening day of the conference. Several authoritative industry speakers presented talks on the technical session, including Ward Harrison, General Electric Company, Nela Park, Cleveland; Henry G. Clum, The Art Metal Company, Cleveland; Rudolph Hultgren, General Luminescent Corporation, Chicago; Dr. D. B. Harmon, Texas State Board of Health, Austin, Texas; and Prof. R. L. Biese, Jr., of Southern Methodist University, Dallas.

That the Southwest has many fine lighting installations to be proud of



Back in harness again after six years service in the U. S. Army Ordnance Dept. and Engineer Corps., Col. Carl E. Heimbrodt recently returned to the staff of the Electric Association of Chicago. He will resume his former activities as head of the local Adequate Wiring program and secretary-treasurer of the West Suburban Electric League and the Electrical Maintenance Engineers group.



**Kleins  
for  
safety's  
sake**

Linemen are Kleinmen because they know that their very safety depends on the quality of the equipment they use. Klein has been their standard "since 1857."

**KLEIN CLIMBERS** assure safe trips up and down the pole. They do not cut out.

**"KLEIN-KORD" RED CENTER SAFETY STRAPS** provide maximum safety—the Red Center unmistakably signals when the strap should be replaced.

**"KLEIN-KORD" TOOL BELTS** give the safety, comfort and convenience needed for fast, efficient work.

**KLEIN PLIERS** with their proper balance, sharp knives and matched jaws help in doing any wiring job better, quicker.

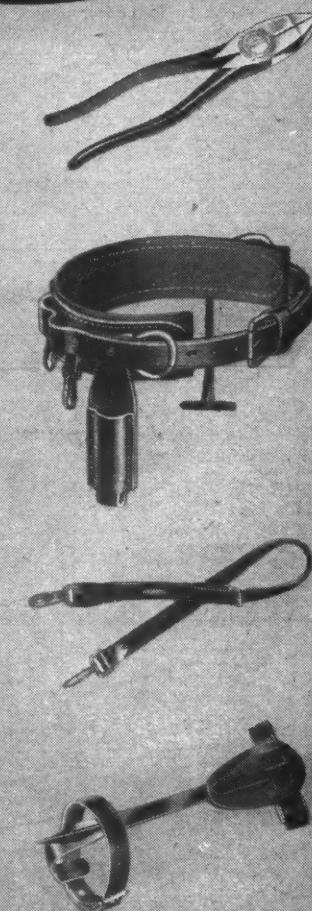
Be sure to equip your linemen with Klein Pliers and equipment. Your supplier will fill your order as rapidly as possible.

Ask Your Supplier

Foreign Distributor: International Standard Electric Corp., New York

The Klein Pocket Tool Guide showing the Klein line and containing useful tool information will be sent on request.

Since 1857

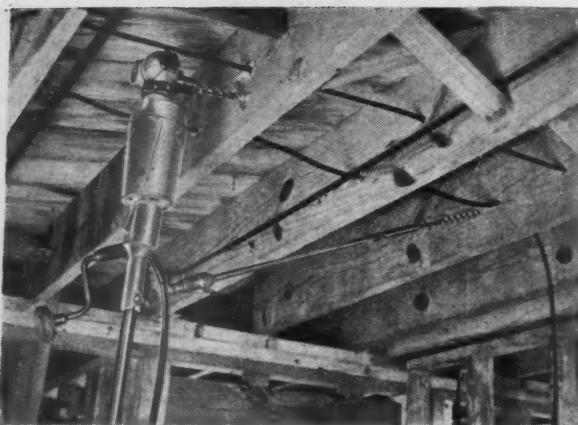


**Mathias KLEIN & Sons**

Established 1857

Chicago, Ill., U.S.A.

3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS



Note hand borer alongside Kett Borer which did 5 day job in a day.



## No More Crooked Holes with the KETT BORER

On wiring jobs, the amazing KETT Borer drills holes in a straight line. Besides its speed, the Borer's in-a-line holes let you string your wire fast, pull it tight with a single motion. On a recent job, one KETT Borer completed a five-day hand job in less than a day . . . paid for itself on the first two or three jobs. And that isn't all . . . this tool bores holes up to 2½" through wood anywhere, at any angle, up to 10 feet high with the Kett extension . . . bores steel and masonry with suitable bits. See your dealer for demonstration or write for Bulletin F.

**The KETT Tool Company**

5 EAST THIRD STREET  
CINCINNATI 2, OHIO

## Bend Conduit Cold-

Here's How



Conduit can be bent  
to any desired angle



90°  
in one operation

In one single operation  
with Tal's Prestal  
Pipe Bender

Installation work goes faster, easier, and at a lower cost when you have a Tal's Prestal Bender on the job. This efficient, light, portable machine handles all pipe and conduit up to 3". Makes perfect bends, up to 90°, cold, in one single operation. No need to waste labor by replacing the pipe three to six times to make a bend. Does a good workmanlike job — smooth, uniform bends without kinks or wrinkles. Simple and easy to operate. Thousands are in successful use everywhere. Write for data bulletin.

**Tal's Prestal Bender, Inc.**  
Dept. EC-6, Milwaukee 2, Wisconsin

was indicated by James E. Bennett, General Electric Supply Corporation, Dallas, who presented an illustrated talk, "Lighting Trends in the Southwest."

Henry G. Clum pointed out that "residence lighting sorely needs the benefit of more skillful application of the fundamentals," in a paper on "A Technical Approach to Residence Lighting."

A noteworthy paper on Illuminating Engineering as a profession was presented by Prof. R. L. Bieseile, Jr. He pointed out that "illuminating engineering as a profession will be whatever we, as illuminating engineers, choose to make it," and further stated that "the rapid advance of lighting practice has probably overshadowed the practice of the profession." His paper provoked a lively discussion, which indicated a feeling that the term "lighting specialist" should be used more often, rather than the term "illuminating engineer."

Ward Harrison presented his paper on "Glare Ratings," recently published in *Illuminating Engineering*, official organ of the Illuminating Engineering Society. Mr. Harrison, who has made a comprehensive study of the subject of brightness and glare, told the conference that "it is impossible to have visual comfort under inadequate illumination, or under too great brightness—which is glare."

Another stimulating and interesting paper, "Color in School Rooms," illustrated with color movies and slides, was presented by Dr. D. B. Harmon. Color has a significant place in the school room, Dr. Harmon stated, and explained the reasons why, including its effects on the visual processes.

Rudolph Hultgren presented a highly technical and instructive paper on "Design of Cold Cathode Lighting."

A well rounded program, incorporating speakers from all segments of the lighting industry and stressing indirectly the interdependence of all groups, comprised the Lighting Sales Conference held on the first day, preceding the Technical Session. This program, presided over by R. F. Scott, Southwestern Gas & Electric Company, Shreveport, La., and H. G. Hrvnat, Houston Lighting & Power Company, Houston, Texas, got underway when W. E. Folsom, Dallas Power & Light Company presented a paper, "Selling Co-ordinated Lighting," in which he pointed out that "the practice of illumination has become humanized."

R. F. Scott pointed out that the contractor, the wholesaler, the manufacturer and the electric utility all have the same object, to increase income through increased sales, in his

talk on "Inter-Relationships in Selling Lighting."

L. E. Harris of the Gulf Electric Company, Houston, Texas, spoke for the contractor group. He said that the contractor was definitely the weakest link in the chain, and pointed out, "The truth is that we contractors must realize that we are not selling just light and fixtures... Selling lighting is an expert business... If we contractors will put forth the necessary effort to find out something about lighting, and then take advantage of the brains available, we'll begin to learn something about what we talk about. The sooner we get educated to our responsibility, the sooner we'll make some real progress."

Frank X. Chassaing, Southern Electric Supply Co., Houston, spoke for the electric wholesalers; G. C. Buchanan, District Lighting Specialist for the General Electric Company, Dallas, spoke for the manufacturers; and A. E. Warner, Oklahoma Gas & Electric Co., Oklahoma City, spoke for the electric utility group, which concluded the morning session.

Walter G. Moore, Vice President and General Manager of the Dallas Power & Light Co., was luncheon speaker and gave a talk on "An Executive's View of Lighting Sales."

The afternoon session was an open forum, and included discussions of "Utility Lighting Sales Operations," by C. T. Blum, Houston Lighting and Power Co., Houston; "Customer and Trade Contacts," by H. G. Hrinatz, Houston Lighting and Power Co., "Lighting Layouts and Recommendations," by J. N. Brauman, Texas Electric Service Co., Fort Worth, Texas; "Lighting Sales Training," by W. D. Knight, Southwestern Public Service Co., Amarillo, Texas; "Lighting Sales Promotion," by P. M. Rutherford, Jr., Dallas Power & Light Co., "Measurement of Sales Results," by C. B. Barron, Gulf States Utilities Co., Beaumont, Texas; "A New Market—Germicidal Radiation," by J. D. Gladstone, Tru-Air Ultraviolet Products Co., Los Angeles, Calif.; and "Planned Lighting Maintenance," by Joe Edwards, Sylvania Electric Products, Inc., Kansas City, Mo.

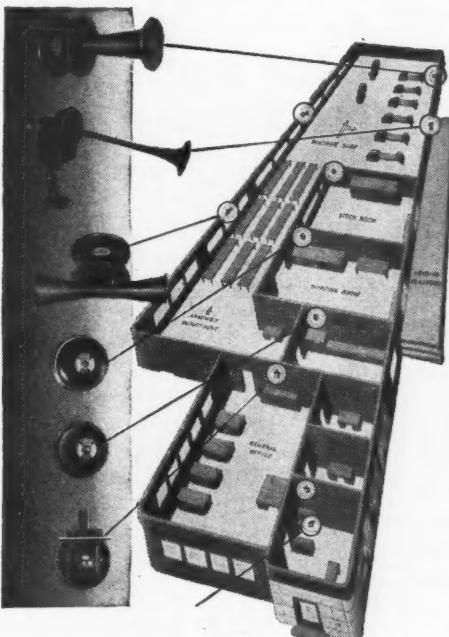
A film, "Color Conditioning in Industry," was shown by H. L. Wills, E. I. du Pont de Nemours & Co., Dallas, which shows that scientific painting has become an important factor in scientific illumination. It also included a suggested safety color code, successfully adopted by many plants.

The last day of the conference was devoted to joint meetings of the boards of managers of the Sections and Chapters of the Southwestern Region, including officers of the study club.



## FARADAY KODEMASTER

Gets the right man in a jiffy!



A long distance call—an important conference—can't wait for the operator to telephone all around the plant. Time is valuable—too expensive to waste! Kodemaster will get the right man in a jiffy—only a few seconds and its message reaches every nook and corner of the plant and the man is located.

Every factory large enough for a telephone switchboard needs the efficient Faraday Kodemaster. It's the ideal system for locating individuals in a hurry—up to 30 different code signals.

Kodemaster is a unique, compact, fool-proof control for old or new signal systems. May be set up with any number or combination of bells, buzzers, horns, Kodaires, chimes, sirens.

For profits now and customer satisfaction that will lead to more business later, recommend and install Faraday Kodemaster.

FARADAY UNIPACT units are interchangeable, "as easy as plugging in a toaster."

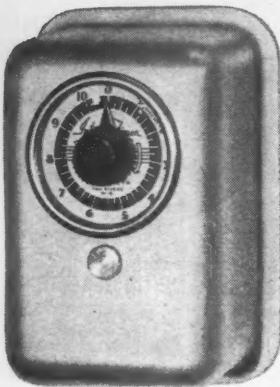
**FARADAY**  
ELECTRIC CORPORATION  
Adrian, Michigan

## EXTRA PROFITS

with attic and window

## fan controls

by *Paragon*



proved for 115 V. A.C.,  $\frac{3}{4}$  H.P. loads  
... accurate and dependable.

• Easy to install, direct to handy box or surface mount with conduit connection through bottom of timer.

For extra profits this spring and summer, get set to install these new timers, now. They work with any A.C. fan, and the setting may be changed at will without harming the instrument. Timer motor runs only when timer is in operation.

List price only \$9.75 F.O.B. Two Rivers . . . an outstanding value.



Order from your jobber now . . . and ask for Sales Aids.

### PARAGON ELECTRIC COMPANY

1614 TWELFTH STREET  
TWO RIVERS . . . WISCONSIN

Since 1905 Paragon Electric Company has planned, designed and manufactured Time Switches, Industrial Timers and other time control instruments. Paragon now makes everything going into its products except the motors . . . which are Warren Telechron.

**Paragon** Two Rivers

BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905

## Fractional HP Motor Production in 1946

The Civilian Production Administration reported recently that 1946 shipments of fractional horsepower a-c motors totalled 19,546,599 units, and that monthly shipments climbed from 873,376 units in January, 1946 to 2,117,943 in December.

This increase of almost 150 percent in the monthly shipment rate was attributed by CPA to the cooperation of industry and government in breaking one of the most serious bottlenecks in the production of a wide variety of civilian goods.

Responsible for much of the rise in the delivery rate of these motors was the equitable distribution to motor manufacturers of silicon sheet steel, copper magnet wire, castings and insulation materials.

Despite the accelerated rate of small motor shipments in 1946, the year ended with a backlog of 40,266,000 unfilled orders, or the equivalent of 19 months' shipments at the December rate.

## Seattle Contractors Elect Officers

J. M. Hooper, Seattle, Wash., has been elected president of the newly-organized Electrical Contractors of Washington, with A. R. Neilson first vice president; Arthur Seigel, second vice president; Fred Engel, recording secretary; J. E. Atkinson, treasurer, and Pat Dubie, sergeant-at-arms. Trustees include Edward W. Packard, Bernie Cohen, Don Meyers, H. E. McKenny and Ed Ekart, while the executive board is made up of Bob Hartzell, Ray Thalberg, Cecil Tice, B. H. Beckstrom and George Lowe.

## Twin-City Contractor Use Good-Will Ads

Electrical contractors in Minneapolis and St. Paul, of necessity, are daily rejecting requests to handle additional work. They, like others throughout the country, just aren't in a position—either from a materials or labor standpoint—to take care of all calls that come into the shop.

In an endeavor to explain present conditions and their specific positions, and to enlist public understanding and patience, the Minneapolis Electrical Contractors Association as well as the St. Paul group are using advertising space in the local newspapers.

## INCREASING YOUR HOLD ON YOUR JOB



and giving yourself  
a chance for advancement

Few men deliberately plan to work persistently on self-improvement. If progress comes naturally, they are happy; if it does not, they either worry or they entirely ignore the situation.

Yet it is possible to pay attention to self-improvement with considerable hope of success. A noticeable degree of advancement is practically assured to anyone who will make an intelligent and persistent effort.

Thousands of men have proved this for themselves, with the use of

## The CROFT Library of Practical Electricity

7 Volumes, 2906 pages  
1948 how-to-do-it illustrations

• The Croft Library is a complete electrical educator. Founded on practice—on 20 years of shirt-sleeve experience—on work as it is actually done. Jammed from cover to cover with the kind of hardheaded facts you want. Written so that the beginner can easily understand it, yet so sound, so thorough, that it is the daily guide of 59,000 highly paid electrical workers and engineers.

• Croft tells you the things you need to know about motors, generators, armatures, commutators, transformers, circuits, switchboards, distribution systems—electrical machinery of every type—illumination in its every phase—the most improved methods of lighting—lamps and lamp effects, etc.—how to do a complete job, from planning it, to completion.

NO MONEY DOWN  
EASY PAYMENTS  
10 DAYS' FREE EXAMINATION

Fill in and mail the coupon below and we will send you the entire set of seven volumes for ten days examination on approval. We will take all the risk—you assume no obligation. If you decide to keep the books, send \$3.50 in ten days and the balance at the rate of \$4.00 a month.

Send this McGRAW-HILL coupon

McGRAW-HILL BOOK CO.  
330 W. 42nd St., New York 18, N. Y.

You may send me the seven volumes of the Croft Library of Practical Electricity for 10 days' examination. I agree to return the books, postpaid, in ten days or remit \$3.50 then and \$4.00 a month until the special price of \$19.50 has been paid.  
(To insure prompt shipment, write plainly and fill in all lines.)

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For Canadian price write Embassy Book Co.,  
12 Richmond Street E., Toronto 1.

**Revere**  
ELECTRIC MFG CO. CHICAGO, ILL.

for MINE!



There's no equal to this line when it comes to easy wiring and easy maintaining. Revere units meet every requirement BETTER!

**Service Station—Sports  
Lighting Equipment—Airport,  
Industrial—  
Marine**



AIRPORT FLOOD-LIGHTS 12 in., 18 in., 24 in. lens sizes. A masterpiece in design and construction.



OPEN AND ENCLOSED FLOODS 150 to 1500 Watt for any type of mounting. Also portable models.

**REVERE ELECTRIC MFG. CO.**

6017 Broadway — Chicago 40, Ill.

ILSCO OPERATES  
ITS OWN TUBE MILL

An oval-shaped black and white advertisement for Collyer. The word "Collyer" is written in a large, white, cursive script font. Below it, the text "ASBESTOS and A.V.C. WIRES and CABLES" is displayed in a bold, sans-serif font. At the bottom of the oval, several dark-colored, textured wires and cables are shown, some with insulation and some stripped, illustrating the products mentioned in the text.

# Defy Heat!



Heat holds no terrors for the "fire-eater" — or for Collyer Asbestos Wires. The heavy overloads and hot locations that break down ordinary insulations do not affect Collyer asbestos. Where moisture, corrosive vapors, and heat up to

230° F. are expected, Collyer Asbestos Varnished Cambric (A.V.C.) insulation is recommended. Made by improved methods, with new non-toxic resin impregnating compounds, this wire is ideal for control and power circuits in steel mills, foundries, mines, and boiler rooms, for voltages up to 7500. Collyer All-Asbestos Wire withstands extreme temperature, up to 400° F. under dry conditions, on rheostats, control panels, heating equipment, etc., and gives maximum protection against overloads or high ambient temperatures.

*Write for information*

# Collyer INSULATED WIRE CO.

245 ROOSEVELT AVE., PAWTUCKET, R. I.

Performance Proved

## SOLAR STARTERS

FOR ALL STANDARD  
FLUORESCENT  
LIGHTING EQUIPMENT

Made to exacting specifications, SOLAR Fluorescent Starters are engineered to insure efficient lamp performance and are pre-tested in actual service. A twist of the wrist locks them firmly in position for perfect starting contact. For new equipment or replacement.



Prompt - Dependable  
- Quick - "P-D-Q"  
Starters start in one-  
second or less. For  
better performance,  
longer lamp life, less  
maintenance, it's  
SOLAR "P-D-Q"  
Starters.

U. L. APPROVED



SOLAR "Glow-Type"  
Starters give dependable  
starting and restarting  
in two to three seconds. Approximately  
6,000 lamp starts per  
starter. Reliable - eco-  
nomical.

U. L. APPROVED



For More  
Information

WRITE

SEND DATA SHEET No. U-6b.

Name \_\_\_\_\_  
Company \_\_\_\_\_  
Street \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_  
Type of Business \_\_\_\_\_

**SOLAR ELECTRIC CORPORATION**  
FACTORY and SALES OFFICES  
WARREN, PENNSYLVANIA



**NISA President R. B. Turner of Windsor, Ontario, Canada, addressed the New England Chapter's Foreman's Meeting in Boston. Jack Reddington of Boston, N. E. Chapter President, listens to President Turner's plea for continued exchange of shop practice ideas among NISA members.**

## DATES AHEAD

**Edison Electric Institute**—15th Annual convention, Atlantic City, N. J., June 2-5.

**Pacific Coast Electrical Assn., Inc.**—Mission Inn, Riverside, Calif., June 4-6.

**Illinois Chapter IAEI**—Seventeenth Mid-year meeting, Hotel LeClaire, Moline, Ill., June 5-6.

**American Society of Refrigerating Engineers**—34th Spring meeting, Hotel Alexandria, Los Angeles, Calif., June 9-11.

**American Institute of Electrical Engineers**—Summer meeting, Montreal, Quebec, Canada, June 9-13.

**New York State Association of Electrical Contractors and Dealers, Inc.**—Saranac Inn, Saranac, N. Y., June 10-15.

**National Electrical Manufacturers Association**—Special section meetings, The Homestead, Hot Springs, Va., June 22-26.

**Illuminating Engineering Society**—Annual convention, New Orleans, La., September 5-10.

**National Electrical Contractors Association**—Annual meeting, Palace Hotel, San Francisco, Calif., September 8-10.

**Illuminating Engineering Society**—Technical Conference, Roosevelt Hotel, New Orleans, La., September 15-19.

**International Association of Electrical Inspectors**—Northwestern Section, Eugene Hotel, Eugene, Ore., Sept. 22-24; Southwestern Section, Mission Inn, Riverside, Calif., September 29-October 1; Western Section, Mount Royal Hotel, Montreal, Quebec, Canada, October 13-15; Eastern Section, Seaside Hotel, Atlantic City, N. J., October 20-22; Southern Section, Hotel George Washington, Jacksonville, Fla., October 27-29.

**International Municipal Signal Association, Inc.**—Annual meeting, Pantlind Hotel, Grand Rapids, Mich., September 29-October 2.

**National Safety Congress & Exposition**—Chicago, Ill., October 6-10.

**National Electrical Manufacturers Association**—Traymore Hotel, Atlantic City, N. J., Week of Oct. 26.

**American Institute of Electrical Engineers**—Midwest meeting, Chicago, Ill., November 3-7.

**2nd International Lighting Exposition**—Hotel Stevens, Chicago, Ill., November 3-7.

**National Metal Trades Association**—Palmer House, Chicago, Ill., November 6-17.

**National Association of Manufacturers**—Waldorf-Astoria Hotel, New York, N. Y., December 3-5.

**PROMPT SERVICE FROM**

**The Jiffy Line**

**"Jiffy" SNAP-IN BLANKS**



"Jiffy" Knockout Seats are safe, cost less and are easy to install. Only one piece, they snap into place. No tools necessary.

**"Jiffy"**



**ADJUSTABLE HOLE CUTTER**

Cuts clean round holes quickly, easily, and accurately through steel plates, boxes, iron, fibre and other materials. Ratchet wrench and spring pressure make it easy to operate in corners and cramped positions. Also available for use with drill press.

**"Jiffy" SOLDER DIPPER**



A practical tool for electricians. Lasts a lifetime. It doesn't spill or waste solder, or burn the insulation.

**SOLD BY YOUR JOBBER**

Write for "Jiffy" folder EC for full details.

**CLYDE W. LINT CO.**

Room 300, 1144 W. Washington Blvd.  
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**WE BUILT A BETTER**



**ROTARY  
CONCRETE  
DRILL**

**COME ON NOW AND BEAT  
A PATH TO OUR DOOR . . . !**

- Makes concrete drilling easy.
- Drills concrete, brick, granite and marble.
- Drills 85% faster than star drills.
- Drills precision holes; not deflected by rocks.
- Pulverizing action; no sharp point to wear.
- Used by leading contractors.
- Can be resharpened at nominal cost.
- For use in any rotating drill.
- All standard sizes.  $\frac{1}{4}$ " to 2". Larger sizes made to order.

**WRITE NOW FOR PRICES.**

Phone SYcamore 2-4734



**Rotary Concrete Drill Co.**

650 South Arroyo Parkway  
PASADENA 2, CALIFORNIA

# MANUFACTURERS NEWS

## C. D. HEPLER HEADS TRUMBULL SALES DEPARTMENT

Carroll D. Hepler, vice president, has been placed in charge of all sales activities of the Trumbull Electric Manufacturing Company.

A native of Seattle, Mr. Hepler attended the University of Washington. He was employed as assistant to the



C. D. HEPLER

president of the A. G. Manufacturing Company of Seattle and Los Angeles when that firm was acquired by the Trumbull Company in 1929. Mr. Hepler became president of the Trumbull Pacific Division in January 1945 and was elected vice president of the parent Trumbull corporation a year later.

## LIGHTING PRODUCTS CHANGES

Robert H. Ehret has been appointed assistant sales manager of The Electric Products Company, Cleveland, Ohio. He will be responsible for handling headquarter sales negotiations.

Gordon J. Berry, vice president and sales manager, announces the opening of a new district office in Chicago at 915 Old Colony Building, 407 South Dearborn Street. Robert R. Kovach has been named district manager.

## G-E APPOINTMENTS

L. M. Biggs has been named manager of the General Electric Company's Construction Engineering Division. Mr. Biggs, who has been assistant manager of this division, succeeds C. M. Rhoades, who has retired.

The appointment of Homer A. Rawson as sales manager of G-E lighting components has been announced.

Floyd M. Shumway and R. S. Oschner have been appointed North Central district representatives of G-E's accessory equipment products, tungar and metallic rectifiers respectively.



## A Roll Cooked Up by Experts

Like skilled chefs, tape experts in the Jenkins laboratory check every step in the manufacture of Gold Seal. That's why Gold Seal always has plenty of tack . . . never ravel, peels, smears your hands, or dries out. Ask for Gold Seal, by the box or the handy ten-roll can. Every roll is cellophane wrapped. Jenkins Bros. (Rubber Division) 80 White Street, New York 13, N. Y.



JENKINS *Gold Seal Tapes*

FRICITION - RUBBER

MADE BY JENKINS BROS . . . MAKERS OF FAMOUS JENKINS VALVES

WHEN IT'S A REFLECTOR INSTALLATION FOR



**QUAD**  
FLOODLIGHTS

ARE YOUR CORRECT  
AND PROFITABLE  
ANSWER

ANY SIGN • ANY LOCATION • ANY CONDITION



Competition in business means better lighting of sign boards. Here, there, and everywhere, signs featuring products will be illuminated to greatest readability and attractiveness, with QUAD UNITS. Round Angle Sign Reflectors—Rectangular Angle Sign Reflectors and Spade Sign Reflectors make up a line that makes sales for you.

The weatherproof feature—the easy wiring feature—the flexibility—the uniform distribution of light and the interchangeable feature with QUAD sockets are among the many features you should investigate now. The times are ripe for good business.

**QUADRANGLE MFG. CO.**

32 S. PEORIA ST.

CHICAGO 7, ILL.



## THEY'RE ALL ALIKE

in 2 Important Ways!  
Every KONDU Fitting



Only with Kondu can you take one fitting out of the line and put in another, without disturbing conduit . . . or put up conduit before the fittings are delivered. Only with Kondu can you use either standard conduit or thin-wall, at any outlet. Kondu fittings are vibration-proof. Practically unbreakable . . . 100% re-usable. Write for the Kondu Catalog.

**KONDU CORPORATION, Erie, Pa.**  
KONDU MFG. CO. LTD., Preston, Ontario



The appointment of George H. Hopkins, Jr. as Great Lakes district representative for wiring devices has been announced.

R. M. Darrin has been appointed assistant district manager of the Central Station Division, New York district.

### CROUSE-HINDS APPOINTMENTS

The Crouse-Hinds Company announces the appointment of E. R. Monesmith as general sales manager



E. R. MONESMITH

with headquarters at Syracuse, N. Y.

R. R. Northrup was named assistant to the general sales manager and A. F. Hills, vice president, continues as director of sales.

### WESCO PERSONNEL CHANGES

T. B. Kalbfus has been appointed manager, Market Development, of the Westinghouse Electric Supply Company, reporting to D. M. Salsbury, executive vice president. Prior to his appointment, Mr. Kalbfus was Southern California district sales promotion manager at Los Angeles.

G. M. DeKraker, former branch manager of the Amarillo, Texas branch, has been named Southwestern district apparatus and supplies manager. He succeeds Houston B. Watson, resigned.

Richard Scott, former apparatus and supplies salesman at the Dallas Branch has been appointed branch manager of the Amarillo, Texas branch.

### FARIES APPOINTMENTS

Faries Mfg. Company, Decatur, Ill., has made three recent additions to their field sales staff. E. C. Gaskill, formerly representative of Emerson Electric Company in Detroit, has been appointed field representative covering the state of Michigan and Northern Ohio.

W. F. Schiefelbein, formerly with Graybar Electric Co. in Minneapolis, is now covering Minnesota, Western Wisconsin and the Dakotas.

Robert M. Whelan, formerly with American Wire Co. has been appointed New England representative.

**I·D·E·A**  
INTERNATIONAL DIESEL ELECTRIC AUXILIARY

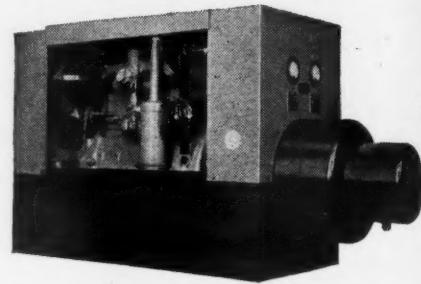
**POWER**

**ELECTRICITY**

**When and Where You Need It**

The thorough dependability and economy of I·D·E·A units result from advanced engineering and the combination of world-famous International Harvester Engines and the finest electric generators made. I·D·E·A units range from 3 KW to 50 KW (either AC or DC). All possess PLUS advantages users can see immediately. A choice of gasoline or diesel driven models to suit every requirement.

**DEALERS:** I·D·E·A Power represents today's BIG opportunity for steady sales and profits. Write for details.



INTERNATIONAL DIESEL ELECTRIC CO., INC.  
LONG ISLAND CITY, N.Y.

"A TORK CLOCK IS A FAMOUS NAME FOR TIME SWITCHES



# TORK

## CLOCKS

For all types of electrical switching and time control Tork Time Clocks will control operations efficiently and automatically. Self-starting, all-electric. A variety of models; for minutes, hours, days, or weeks. Plain or Astronomic Dials.



Write for Bulletins

Price from \$13.00 list.

### OTHER TORK PRODUCTS

**TORK PERSONAL:** Portable plug-in switch for home or office. Capacity 660 Watts. All standard features.

**TORK THERM:** for automatic and efficient heating control; 'steady,' 'intermittent,' and 'off' control. For oil, coal, or gas.

**WEEKLY CALENDAR WHEEL:** Optional feature on all standard models provides for automatically skipping one or more days each week.

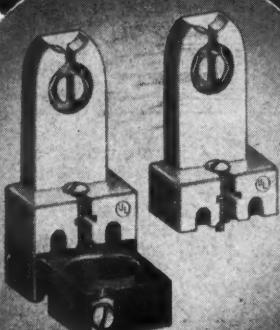
**POULTRY LIGHTING CLOCKS:** Standard models for automatic Bright-Dim lighting equipment control for poultry houses.

**RELAYS AND CONTACTORS** • **SPRING-DRIVEN MODELS** • **CAM OPERATED TIMERS** • **CLOCKS FOR SPORTS AND GAMES** • **SELECTOR WHEELS** • **TIME DELAY CIRCUITS** • **FREEZALARM FOR REFRIGERATION PROTECTION**

**TORK CLOCK CO.**  
MOUNT VERNON, NEW YORK

P&S

## FLUORESCENT LAMPHOLDERS



*Designed WITH  
THE USER IN MIND*

Yes, P&S know-how, resulting from over fifty years' experience in the manufacture of precision-made wiring devices, gives you these important features:

- Rugged Construction
- Highest Quality Material
- Easy, quick installation
- Long life contacts that hold lamps securely
- Ample binding screws (backed out and spun)
- Fitting slots that simplify removal and replacement of lamps
- Approved by Underwriters' Laboratories

### DEPENDABLE DELIVERIES

Send for complete information

PASS & SEYMORE, INC.  
SYRACUSE 9, N. Y.

## SYLVANIA ELECTRIC CHANGES

Grenville R. Holden, formerly assistant to the president, was elected a vice president of Sylvania Electric Products Inc.

Gordon S. Hughes has been appointed merchandising manager of the fixture division of Sylvania.

J. C. Hicks, formerly of Sylvania's California Division has been named manager of the Southwestern Division in Kansas City.

The Gibson Electric Company, Pittsburgh, Pa. has named J. H. Scott as sales representative. He will make his headquarters at 823 Commerce Building, Rochester N. Y. and cover Watertown, Binghamton as well as all of New York State west of these cities.

W. M. Hicks has been appointed sales representative and will cover the New York metropolitan area, including Northern New Jersey. His headquarters are at 41 Park Row, New York City.

The Miller Company, of Meriden, Conn., has appointed C. H. Phillips as field representative of its illuminating division, to cover the Tennessee, North Carolina and South Carolina territories. He will reside in Greensboro, N. C.

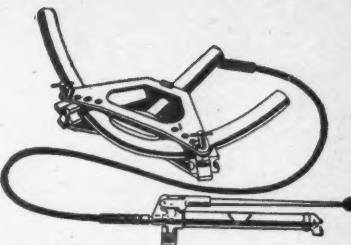
The Holophane Company, Inc., New York, announces the appointment of Gene G. Rae as manager of the Controlens Division.

La Salle Lighting Products, Inc. and Markel Electric Products, Inc., have purchased the building located at 107-111 Carroll Street, Buffalo, N. Y.

Burlingame Associates Limited, 11 Park Place, New York City, have been appointed to represent Eastern Amplifier Corporation, New York, in the New England states, Metropolitan New York, New Jersey, Eastern Pennsylvania, Maryland, Delaware and District of Columbia.

The appointment of G. Taylor Stanton as manager of engineering of Holtzer-Cabot Division of First Industrial Corporation, has been announced.

The Bryant Electric Company recently consolidated its West Coast District offices and warehousing operations in a new location at 3310 Leonis Blvd., Los Angeles, Calif. R. L. Gill, Jr. is manager of the West Coast District.



**When you buy a  
BENDER**  
...check to make sure  
you get these features:

**EASY TO GET TO THE JOB**  
 Lightweight, portable—one man can easily take a Blackhawk Pipe Bender right to the job. Bends rigid conduit and pipe in all popular sizes, up to 4" dia.

**WORKS AT ALL ANGLES**  
 The compact hydraulic Porto-Power Ram is all-directional. Power eliminates need for heating the pipe.

**WORK OVERHEAD**  
 All-directional operation and light weight enlarges range of utility to use on ladders, scaffolds and cramped quarters, and work on existing pipe runs.

**SIGHT FROM ANY ANGLE**  
 Remote control permits operator to stand in any position for a full view of the job. Saves need for elbows, couplings, cutting and extra threading.

**DETACHABLE POWER UNIT  
FOR EXTRA UTILITY**  
 It pulls gears, lifts machinery, and licks scores of other trouble jobs.

**BLACKHAWK  
Porto-Power  
PIPE BENDERS**

BLACKHAWK MFG. CO.  
Dept. P-2067, Milwaukee 1, Wis.  
Mail Hydraulic Equipment catalog to:

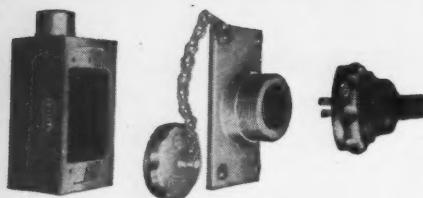
NAME \_\_\_\_\_

COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

# Watertight Plugs and Receptacles

WITH STANDARD ATTACHMENT  
PLUG RECEPTACLES



This equipment is ideal for outdoor floodlight and portable tool uses, for trailer camp connections, and any other location where completely weatherproof plug and receptacle installations are needed.

The receptacle shown fits standard FS and FD Pylets, and is also available with round flange for single and three gang assemblies. Receptacle takes standard 2 pole attachment plugs and is also available for three pole plugs, with or without one pole grounded. Threaded housing is galvanized cast iron; threaded cap is aluminum.

The watertight plugs have standard attachment plug caps with cord clamp, and are equipped with soft rubber hood and aluminum threaded nut for watertight connection to outlet receptacle.

Rating: 10 amp. 250 v.; 15 amp. 125 v.

Consult your Pyle Catalog for complete listings.

1897 • FIFTIETH ANNIVERSARY • 1947

THE PYLE-NATIONAL COMPANY

1344 N. Kostner Avenue, Chicago 51, Illinois

## TELEVISION ANTENNA

### SYSTEMS

[FROM PAGE 67]

25 dollars per outlet. As many as 50 to 75 outlets were served on each installation. Amplifier type systems for broadcast and short wave were installed in about 100 buildings in the New York area up to 1941 and cost about 50 dollars per outlet.

Television master antenna systems vary in design details but follow quite similar patterns. The non-amplified systems designed by Amy, Aceves and King and by RCA both employ single broad band antennas, balanced transmission lines and a resistive network at each outlet. Each serves a maximum of six outlets per system. The RCA system, intended primarily for dealer demonstrations has a fixed number of six outlets all of which are installed even if fewer are needed. The Amy, Aceves and King system has adjustable resistor pads which are proportioned according to the number of outlets required.

In areas close to television broadcast stations, the non-amplified system may be adequate for small apartment houses. A separate antenna and transmission line are required for each six outlets and, since antennas can cause reflection and interference, they must be separated as widely as possible.

#### Amplified Systems

The type of antenna system which offers the best reception, requires only a single antenna array and can serve large numbers of outlets is the amplified system. The general operating principles are similar in the several makes. The antenna is usually an array of dipoles for the several frequency bands. Signals are fed through transmission lines to amplifiers for each frequency band and the output of all coupled to a single transmission line.

The amplifier provides a strong signal which overcomes the cable losses and the losses at the outlets which is necessary to prevent interference between receivers. Amplifier systems usually provide not only the television bands but conventional broadcast, short wave and FM.

Amplifiers are located near the roof. A typical four channel installation consumes in the order of 120 watts. The transmission line is RG/58U coaxial cable with 53.5 ohm characteristic impedance. A group of distribution transformers feed branch transmission



## Automatic TIME SWITCHES

of precision

- Synchronous
- Manually Wound

Stock Models from  
1100 to 4950 Watts  
per pole.

#### CHECK THE Automatic LINE

For any load . . . for every installation, there is an Automatic Time Switch to meet the most rigid specification. Compact, ruggedly constructed Automatic Switches have pure silver contacts . . . tamper proof cabinets with visible dial . . . 2 to 24 "on" and "off" operations. For dependable automatic time switches specify Automatic.

#### Specifications and Information

Time Switches  
Interval Timers  
Poultry Switches  
Flashers  
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Progressive jobbers  
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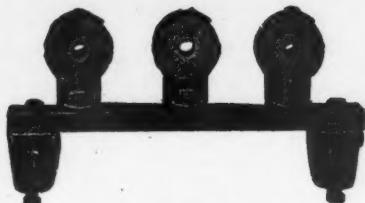
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lines which terminate in the set outlets. The outlet has a coaxial connector for the television set and FM and a three pin jack for broadcast and short wave.

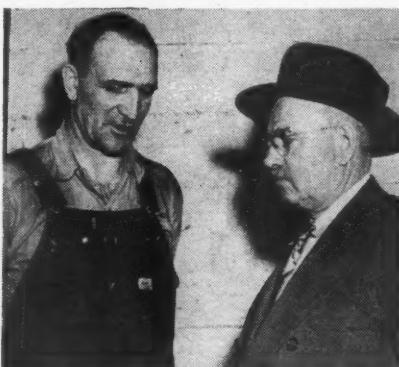
### Raceway Systems

In new buildings raceway systems should be installed according to the distribution plan of the particular make of system that is to be installed. For non-amplified systems each line will serve six sets. A separate "home run" to the roof for each group of six outlets is advisable since the runs should be as short as possible. However, coaxial cables may be run together in the same conduit without interference. Conduit should be  $\frac{1}{2}$  inch for single cables,  $\frac{3}{4}$  inch for two and three cables and 1 inch for five to eight.

A 4-11/16 square box (72171) with single plaster cover will provide ample room for the outlet and set connector equipment. Provision should be made for power supply to the amplifier locations. Pull and junction boxes should be figured on about the same basis as handling No. 14 copper wire (which approximates the diameter of RG/58U coaxial cable).

Detailed layouts for buildings of various sizes and floor arrangements are now available (or soon will be) from the antenna system manufacturer. On new construction where there are no systems now specified or where pre-war radio distribution raceways are specified, it is particularly important to obtain an up-to-date layout.

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Pondering a knotty field problem during an electrical system changeover in a Minneapolis hotel are contractor Frank T. Langford (right), Langford Electric Company of Minneapolis and his job superintendent Carl H. Gause.

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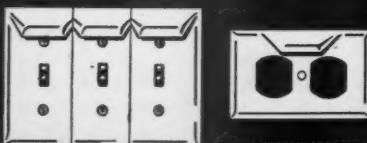
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**INDUSTRIAL LIGHTING  
TECHNIQUES** [FROM PAGE 74]

loads has promoted the use of transformers located in the plant near load centers to supply power to the lighting circuits. Banks of three single-phase dry-type transformers can be fed from the 3-phase 3-conductor busduct system to obtain desirable lighting circuit

**TABLE II**  
Ballast and Transformer Efficiencies<sup>1</sup>

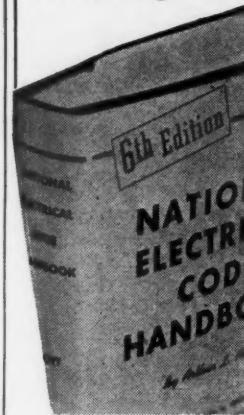
Type of Ballast	Total Lumens	Approx. Watts	Lumens/ Watt <sup>2</sup> (Total Watts)
1-40/110-125	2300	9.5	46.5
1-40/199-216	2300	8.5	47.5
1-100/110-125	4200	24.0	33.9
1-100/200-250	4200	30.0	32.3
2-40/110-125	4600	15.5	48.2
2-40/199-216	4600	11.5	50.3
2-40/220-250	4600	12.5	49.8
2-40/240-280	4600	15.0	48.5
3-40/110-125	6900	23.0	48.2
3-40/199-216	6900	14.0	51.5
3-40/220-250	6900	15.5	50.9
2-100/110-125	8400	32.0	36.2
2-100/199-216	8400	32.0	36.2
2-100/220-250	8400	32.0	36.2
2-100/240-280	8400	35.0	35.8
4-100/240-280	16800	36.0	38.5
1-400/220-250	16000	52.0	35.4
2-400/220-250	32000	80.0	36.4
1-3kw/437-483	120000	220.0	37.3

<sup>1</sup> Based on high power-factor, 60 cycle units, 3500-degree white fluorescent lamps, and standard mercury vapor lamps.

<sup>2</sup> Ratio of total lamp lumens generated to lamp wattages plus watt loss in ballasts.

Source: General Electric Co. Bulletin LD-1, May 1946.

**How to handle all kinds  
of wiring and installation  
jobs . . .**



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